HAND BOOK

LANCASTER TANKS

LANCASTER IRON WORKS INC.
LANCASTER, PENNSYLVANIA

Hand Book
On Steel Tanks

CONTAINING

Specifications of Standard Sizes
and Capacities

Fire Protection and Insurance Requirements
for the
Storage and Use of Volatile Liquids

Specifications of Steels
for Various Purposes

Useful Information and Data
in connection with
Design and Installation.

LANCASTER IRON WORKS, INC.
LANCASTER, PENNSYLVANIA

370 Lexington Ave.
NEW YORK CITY

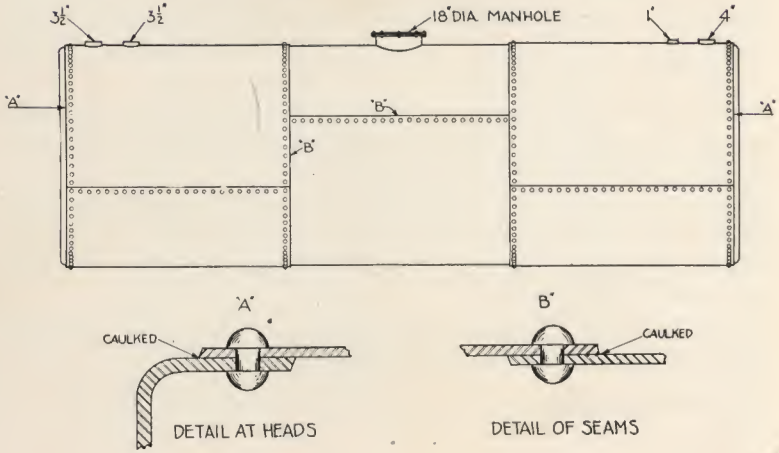
Land Title Building
PHILADELPHIA, PA.

The Lancaster Name Plate

When a Lancaster Tank or Steel Plate job is finished, this Lancaster name plate is attached.

It carries, besides the reference number, a definite message: It presents our declaration that the product bearing this insignia is thoroughly well made and is your guarantee that you will receive from it the fullest measure of efficient service and long life.

All Riveted Horizontal Storage Tanks for Water, Gasoline, Oil, Etc.



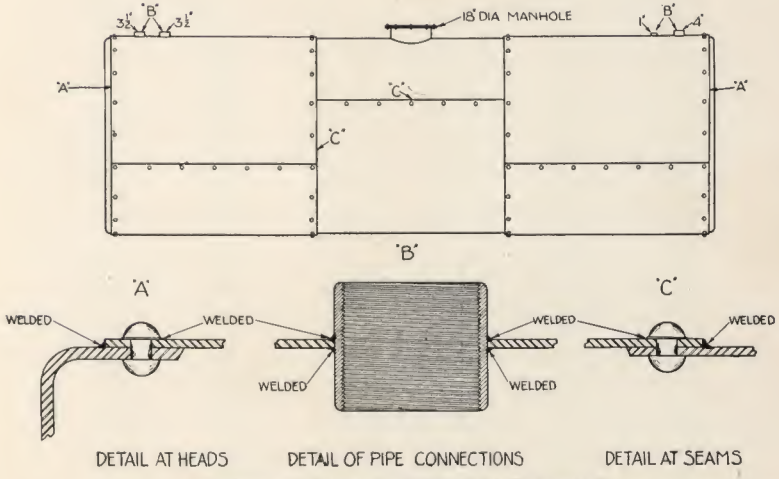
Our Tanks include Standard Openings and Manhole equal to or as shown above.

See page 15 for Extras on Special Openings.

All L. I. W. Tanks are built to comply with State and Insurance Laws governing the storage and usage of inflammable and combustible liquids.

See Specifications of Standard Storage Tanks 100 to 25,000 Gallons capacity, Pages six to fourteen inclusive.

Riveted and Welded Horizontal Storage Tanks for Water, Gasoline, Oils, Etc.



"Riveting for Strength—Welding for Tightness"

In this method of constructing Storage Tanks only about one-fourth the usual number of rivets are used. The seams and rivets instead of being caulked are welded, so that there is no chance for a leak. The rivets give the tank rigidity and insure that the plates remain in the desired position during welding. Welding does away with the possibility of the seams and rivets opening up while the tank is in transit; or from the handling it gets while being installed.

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
24″	5 ′0″	9/64″	9/64″	115	275
24″	5 ′0″	3/16″	3/16″	115	375
30″	5 ′0″	9/64″	9/64″	180	355
30″	5 ′0″	3/16″	3/16″	180	475
36″	5 ′0″	3/16″	3/16″	260	565
36″	5 ′0″	1/4″	1/4″	260	800
36″	6 ′0″	3/16″	3/16″	315	650
36″	6 ′0″	1/4″	1/4″	315	910
36″	7 ′0″	3/16″	3/16″	370	775
36″	7 ′0″	1/4″	1/4″	370	1020
36″	8 ′0″	3/16″	3/16″	425	850
36″	8 ′0″	1/4″	1/4″	425	1140
42″	5 ′0″	3/16″	3/16″	360	680
42″	5 ′0″	1/4″	1/4″	360	935
42″	6 ′0″	3/16″	3/16″	430	770
42″	6 ′0″	1/4″	1/4″	430	1065
42″	8 ′0″	3/16″	3/16″	500	1000
42″	8 ′0″	1/4″	1/4″	500	1300
42″	10 ′0″	3/16″	3/16″	715	1185
42″	10 ′0″	1/4″	1/4″	715	1590
48″	5′6″	3/16″	3/16″	500	840
48″	5 ′6″	1/4″	1/4″	500	1150
48″	6 ′0″	3/16″	3/16″	560	890
48″	6 ′0″	1/4″	1/4″	560	1210
48″	8 ′0″	3/16″	3/16″	750	1100
48″	8 ′0″	1/4″	1/4″	750	1490
48″	11 ′0″	3/16″	3/16″	1000	1400
48″	11 ′0″	1/4″	1/4″	1000	1900
48″	16 ′0″	3/16″	3/16″	1500	1910
48″	16 ′0″	1/4″	1/4″	1500	2590
48″	22 ′0″	3/16″	3/16″	2000	2555
48″	22 ′0″	1/4″	1/4″	2000	3460

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
60″	6 ′0″	3/16″	1/4″	880	1505
60″	6 ′0″	1/4″	5/16″	880	1950
60″	6 ′0″	5/16″	3/8″	880	2130
60″	8 ′0″	3/16″	1/4″	1175	1770
60″	8 ′0″	1/4″	5/16″	1175	2300
60″	8 ′0″	5/16″	3/8″	1175	2770
60″	10 ′0″	3/16″	1/4″	1465	2040
60″	10 ′0″	1/4″	5/16″	1465	2665
60″	10 ′0″	5/16″	3/8″	1465	3220
60″	12 ′0″	3/16″	1/4″	1760	2275
60″	12 ′0″	1/4″	5/16″	1760	2980
60″	12 ′0″	5/16″	3/8″	1760	3610
60″	14 ′0″	3/16″	1/4″	2050	2530
60″	14 ′0″	1/4″	5/16″	2050	3320
60″	14 ′0″	5/16″	3/8″	2050	4040
60″	16 ′0″	3/16″	1/4″	2350	2825
60″	16 ′0″	1/4″	5/16″	2350	3720
60″	16 ′0″	5/16″	3/8″	2350	4535
60″	18 ′0″	3/16″	1/4″	2640	3095
60″	18 ′0″	1/4″	5/16″	2640	4090
60″	18 ′0″	5/16″	3/8″	2640	4990
60″	20 ′0″	3/16″	1/4″	2930	3350
60″	20 ′0″	1/4″	5/16″	2930	4450
60″	20 ′0″	5/16″	3/8″	2930	5420
60″	22 ′0″	3/16″	1/4″	3230	3620
60″	22 ′0″	1/4″	5/16″	3230	4810
60″	22 ′0″	5/16″	3/8″	3230	5885
60″	24 ′0″	3/16″	1/4″	3520	3870
60″	24 ′0″	1/4″	5/16″	3520	5160
60″	24 ′0″	5/16″	3/8″	3520	6300
72″	6 ′0″	3/16″	1/4″	1270	1950
72″	6 ′0″	1/4″	5/16″	1270	2440
72″	6 ′0″	5/16″	3/8″	1270	2920
72″	8 ′0″	3/16″	1/4″	1690	2320
72″	8 ′0″	1/4″	5/16″	1690	2930

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
72″	8 ′0″	5/16″	3/8″	1690	3530
72″	12 ′0″	3/16″	1/4″	2540	3030
72″	12 ′0″	1/4″	5/16″	2540	3845
72″	12 ′0″	5/16″	3/8″	2540	4665
72″	14 ′0″	3/16″	1/4″	2960	3360
72″	14 ′0″	1/4″	5/16″	2960	4270
72″	14 ′0″	5/16″	3/8″	2960	5190
72″	16 ′0″	3/16″	1/4″	3380	3690
72″	16 ′0″	1/4″	5/16″	3380	4695
72″	16 ′0″	5/16″	3/8″	3380	5715
72″	18 ′0″	3/16″	1/4″	3800	4025
72″	18 ′0″	1/4″	5/16″	3800	5120
72″	18 ′0″	5/16″	3/8″	3800	6240
72″	20 ′0″	3/16″	1/4″	4230	4355
72″	20 ′0″	1/4″	5/16″	4230	5545
72″	20 ′0″	5/16″	3/8″	4230	6765
72″	22 ′0″	3/16″	1/4″	4650	4690
72″	22 ′0″	1/4″	5/16″	4650	5970
72″	22 ′0″	5/16″	3/8″	4650	7295
72″	24 ′0″	3/16″	1/4″	5080	5020
72″	24 ′0″	1/4″	5/16″	5080	6395
72″	24 ′0″	5/16″	3/8″	5080	7820
72″	26 ′0″	3/16″	1/4″	5500	5350
72″	26 ′0″	1/4″	5/16″	5500	6820
72″	26 ′0″	5/16″	3/8″	5500	8345
72″	28 ′0″	3/16″	1/4″	5920	5685
72″	28 ′0″	1/4″	5/16″	5920	7245
72″	28 ′0″	5/16″	3/8″	5920	8870
72″	30 ′0″	3/16″	1/4″	6345	6015
72″	30 ′0″	1/4″	5/16″	6345	7670
72″	30 ′0″	5/16″	3/8″	6345	9395
72″	32 ′0″	3/16″	1/4″	6765	6350
72″	32 ′0″	1/4″	5/16″	6765	8095
72″	32 ′0″	5/16″	3/8″	6765	9925
72″	34 ′0″	3/16″	1/4″	7190	6680
72″	34 ′0″	1/4″	5/16″	7190	8520

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
72″	34 ′0″	5/16″	3/8″	7190	10450
72″	36 ′0″	3/16″	1/4″	7600	7020
72″	36 ′0″	1/4″	5/16″	7600	8930
72″	36 ′0″	5/16″	3/8″	7600	10960
84″	6 ′0″	1/4″	5/16″	1725	2950
84″	6 ′0″	5/16″	3/8″	1725	3535
84″	6 ′0″	3/8″	3/8″	1725	3955
84″	8 ′0″	1/4″	5/16″	2300	3485
84″	8 ′0″	5/16″	3/8″	2300	4200
84″	8 ′0″	3/8″	3/8″	2300	4760
84″	12 ′0″	1/4″	5/16″	3455	4610
84″	12 ′0″	5/16″	3/8″	3455	5570
84″	12 ′0″	3/8″	3/8″	3455	6430
84″	14 ′0″	1/4″	5/16″	4030	5080
84″	14 ′0″	5/16″	3/8″	4030	6160
84″	14 ′0″	3/8″	3/8″	4030	7140
84″	16 ′0″	1/4″	5/16″	4600	5555
84″	16 ′0″	5/16″	3/8″	4600	6750
84″	16 ′0″	3/8″	3/8″	4600	7855
84″	18 ′0″	1/4″	5/16″	5180	6025
84″	18 ′0″	5/16″	3/8″	5180	7340
84″	18 ′0″	3/8″	3/8″	5180	8570
84″	20 ′0″	1/4″	5/16″	5760	6500
84″	20 ′0″	5/16″	3/8″	5760	7930
84″	20 ′0″	3/8″	3/8″	5760	9285
84″	22 ′0″	1/4″	5/16″	6330	6970
84″	22 ′0″	5/16″	3/8″	6330	8520
84″	22 ′0″	3/8″	3/8″	6330	10000
84″	24 ′0″	1/4″	5/16″	6910	7445
84″	24 ′0″	5/16″	3/8″	6910	9110
84″	24 ′0″	3/8″	3/8″	6910	10715
84″	26 ′0″	1/4″	5/16″	7435	7915
84″	26 ′0″	5/16″	3/8″	7485	9700
84″	26 ′0″	3/8″	3/8″	7485	11425
84″	28 ′0″	1/4″	5/16″	8060	8390

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
84″	28 ′0″	5/16″	3/8″	8060	10290
84″	28 ′0″	3/8″	3/8″	8060	12140
84″	30 ′0″	1/4″	5/16″	8635	8860
84″	30 ′0″	5/16″	3/8″	8635	10880
84″	30 ′0″	3/8″	3/8″	8635	12850
84″	32 ′0″	1/4″	5/16″	9210	9335
84″	32 ′0″	5/16″	3/8″	9210	11470
84″	32 ′0″	3/8″	3/8″	9210	13570
84″	34 ′0″	1/4″	5/16″	9780	9810
84″	34 ′0″	5/16″	3/8″	9780	12060
84″	34 ′0″	3/8″	3/8″	9780	14285
84″	36 ′0″	1/4″	5/16″	10360	10385
84″	36 ′0″	5/16″	3/8″	10360	12765
84″	36 ′0″	3/8″	3/8″	10360	15150
96″	8 ′0″	1/4″	5/16″	3000	4175
96″	8 ′0″	5/16″	3/8″	3000	4995
96″	8 ′0″	3/8″	3/8″	3000	5555
96″	12 ′0″	1/4″	5/16″	4510	5485
96″	12 ′0″	5/16″	3/8″	4510	6435
96″	12 ′0″	3/8″	3/8″	4510	7495
96″	14 ′0″	1/4″	5/16″	5260	6085
96″	14 ′0″	5/16″	3/8″	5260	7135
96″	14 ′0″	3/8″	3/8″	5260	8375
96″	16 ′0″	1/4″	5/16″	6015	6515
96″	16 ′0″	5/16″	3/8″	6015	7640
96″	16 ′0″	3/8″	3/8″	6015	9250
96″	18 ′0″	1/4″	5/16″	6770	7130
96″	18 ′0″	5/16″	3/8″	6770	8665
96″	18 ′0″	3/8″	3/8″	6770	10130
96″	20 ′0″	1/4″	5/16″	7520	7750
96″	20 ′0″	5/16″	3/8″	7520	9360
96″	20 ′0″	3/8″	3/8″	7520	11005
96″	21 ′6″	1/4″	5/16″	8000	8370
96″	21 ′6″	5/16″	3/8″	8000	10060
96″	21 ′6″	3/8″	3/8″	8000	11885

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
96″	24 ′0″	1/4″	5/16″	9020	8985
96″	24 ′0″	5/16″	3/8″	9020	10755
96″	24 ′0″	3/8″	3/8″	9020	12765
96″	26 ′0″	1/4″	5/16″	9775	9605
96″	26 ′0″	5/16″	3/8″	9775	11455
96″	26 ′0″	3/8″	3/8″	9775	13640
96″	28 ′0″	1/4″	5/16″	10520	10225
96″	28 ′0″	5/16″	3/8″	10520	12155
96″	28 ′0″	3/8″	3/8″	10520	14520
96″	30 ′0″	1/4″	5/16″	11280	10845
96″	30 ′0″	5/16″	3/8″	11280	12850
96″	30 ′0″	3/8″	3/8″	11280	15395
96″	32 ′0″	1/4″	5/16″	12030	11460
96″	32 ′0″	5/16″	3/8″	12030	13550
96″	32 ′0″	3/8″	3/8″	12030	16275
96″	34 ′0″	1/4″	5/16″	12780	12080
96″	34 ′0″	5/16″	3/8″	12780	14245
96″	34 ′0″	3/8″	3/8″	12780	17154
96″	36 ′0″	1/4″	5/16″	13540	12700
96″	36 ′0″	5/16″	3/8″	13540	14945
96″	36 ′0″	3/8″	3/8″	13540	18030
96″	38 ′0″	1/4″	5/16″	14290	13320
96″	38 ′0″	5/16″	3/8″	14290	15645
96″	38 ′0″	3/8″	3/8″	14290	18910
96″	40 ′0″	1/4″	5/16″	15040	13465
96″	40 ′0″	5/16″	3/8″	15040	15815
96″	40 ′0″	3/8″	3/8″	15040	19125
108″	12 ′0″	1/4″	5/16″	5710	6040
108″	12 ′0″	5/16″	3/8″	5710	7345
108″	12 ′0″	3/8″	3/8″	5710	8355
108″	14 ′0″	1/4″	5/16″	6660	6630
108″	14 ′0″	5/16″	3/8″	6660	8350
108″	14 ′0″	3/8″	3/8″	6660	9245
108″	16 ′0″	1/4″	5/16″	7610	7270
108″	16 ′0″	5/16″	3/8″	7610	9125

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
108″	16 ′0″	3/8″	3/8″	7610	10210
108″	18 ′0″	1/4″	5/16″	8565	7910
108″	18 ′0″	5/16″	3/8″	8565	9900
108″	18 ′0″	3/8″	3/8″	8565	11180
108″	20 ′0″	1/4″	5/16″	9520	8555
108″	20 ′0″	5/16″	3/8″	9520	10680
108″	20 ′0″	3/8″	3/8″	9520	12150
108″	22 ′0″	1/4″	5/16″	10000	9195
108″	22 ′0″	5/16″	3/8″	10000	11455
108″	22 ′0″	3/8″	3/8″	10000	13120
108″	24 ′0″	1/4″	5/16″	11420	9840
108″	24 ′0″	5/16″	3/8″	11420	12235
108″	24 ′0″	3/8″	3/8″	11420	14085
108″	26 ′0″	1/4″	5/16″	12370	10480
108″	26 ′0″	5/16″	3/8″	12370	13010
108″	26 ′0″	3/8″	3/8″	12370	15055
108″	28 ′0″	1/4″	5/16″	13320	11125
108″	28 ′0″	5/16″	3/8″	13320	13785
108″	28 ′0″	3/8″	3/8″	13320	16025
108″	30 ′0″	1/4″	5/16″	14275	11760
108″	30 ′0″	5/16″	3/8″	14275	14565
108″	30 ′0″	3/8″	3/8″	14275	16995
108″	32 ′0″	1/4″	5/16″	15220	12405
108″	32 ′0″	5/16″	3/8″	15220	15340
108″	32 ′0″	3/8″	3/8″	15220	17965
108″	34 ′0″	1/4″	5/16″	16175	13050
108″	34 ′0″	5/16″	3/8″	16175	16120
108″	34 ′0″	3/8″	3/8″	16175	18930
108″	36 ′0″	1/4″	5/16″	17130	13690
108″	36 ′0″	5/16″	3/8″	17130	16895
108″	36 ′0″	3/8″	3/8″	17130	19900
108″	38 ′0″	1/4″	5/16″	18080	14335
108″	38 ′0″	5/16″	3/8″	18080	17675
108″	38 ′0″	3/8″	3/8″	18080	20870
108″	40 ′0″	1/4″	5/16″	19035	14970
108″	40 ′0″	5/16″	3/8″	19035	18460
108″	40 ′0″	3/8″	3/8″	19035	21830

Horizontal Storage Tanks

Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
120″	12 ′0″	1/4″	3/8″	7050	7460
120″	12 ′0″	5/16″	3/8″	7050	8510
120″	12 ′0″	3/8″	3/8″	7050	9710
120″	14 ′0″	1/4″	3/8″	8225	8135
120″	14 ′0″	5/16″	3/8″	8225	9355
120″	14 ′0″	3/8″	3/8″	8225	10720
120″	16 ′0″	1/4″	3/8″	9400	8805
120″	16 ′0″	5/16″	3/8″	9400	10195
120″	16 ′0″	3/8″	3/8″	9400	11730
120″	18 ′0″	1/4″	3/8″	10575	9540
120″	18 ′0″	5/16″	3/8″	10575	11100
120″	18 ′0″	3/8″	3/8″	10575	12835
120″	20 ′7 1/2″	1/4″	3/8″	12000	10295
120″	20 ′7 1/2″	5/16″	3/8″	12000	12040
120″	20 ′7 1/2″	3/8″	3/8″	12000	13970
120″	22 ′0″	1/4″	3/8″	12925	11050
120″	22 ′0″	5/16″	3/8″	12925	12980
120″	22 ′0″	3/8″	3/8″	12925	15100
120″	24 ′0″	1/4″	3/8″	14100	11805
120″	24 ′0″	5/16″	3/8″	14100	13920
120″	24 ′0″	3/8″	3/8″	14100	16240
120″	26 ′3″	1/4″	3/8″	15000	12560
120″	26 ′3″	5/16″	3/8″	15000	14860
120″	26 ′3″	3/8″	3/8″	15000	17375
120″	28 ′0″	1/4″	3/8″	16450	13315
120″	28 ′0″	5/16″	3/8″	16450	15800
120″	28 ′0″	3/8″	3/8″	16450	18510
120″	30 ′0″	1/4″	3/8″	17625	14070
120″	30 ′0″	5/16″	3/8″	17625	16740
120″	30 ′0″	3/8″	3/8″	17625	19645
120″	30 ′11″	1/4″	3/8″	18000	14825
120″	30 ′11″	5/16″	3/8″	18000	17680
120″	30 ′11″	3/8″	3/8″	18000	20780
120″	34 ′0″	1/4″	3/8″	20000	15580
120″	34 ′0″	5/16″	3/8″	20000	18620
120″	34 ′0″	3/8″	3/8″	20000	21910

Horizontal Storage Tanks

Dia.	Length	Thickness		Capacity in Gallons	Weight Pounds
		Shell	Heads		
120″	36 ′0″	1/4″	3/8″	21150	16335
120″	36 ′0″	5/16″	3/8″	21150	19560
120″	36 ′0″	3/8″	3/8″	21150	23050
120″	38 ′0″	1/4″	3/8″	22325	17090
120″	38 ′0″	5/16″	3/8″	22325	20500
120″	38 ′0″	3/8″	3/8″	22325	24190
120″	40 ′0″	1/4″	3/8″	23500	17845
120″	40 ′0″	5/16″	3/8″	23500	21440
120″	40 ′0″	3/8″	3/8″	23500	25325
120″	42 ′0″	1/4″	3/8″	25000	18600
120″	42 ′0″	5/16″	3/8″	25000	22380
120″	42 ′0″	3/8″	3/8″	25000	26460
126″	18 ′0″	5/16″	3/8″	11520	11800
126″	18 ′0″	3/8″	3/8″	11520	13630
126″	24 ′0″	5/16″	3/8″	15360	14545
126″	24 ′0″	3/8″	3/8″	15360	16945
126″	30 ′0″	5/16″	3/8″	19200	17345
126″	30 ′0″	3/8″	3/8″	19200	20360
126″	36 ′0″	5/16″	3/8″	23040	20200
126″	36 ′0″	3/8″	3/8″	23040	23715
126″	39 ′0″	5/16″	3/8″	25000	21960
126″	39 ′0″	3/8″	3/8″	25000	25880

Important

Before ordering tanks, be sure to find out what the State Laws are in your district, covering the minimum thickness of plate that can be used for various capacities, and how close to buildings tanks can be located.

If you want us to find this out for you, we will do so gladly.

See following pages for Installation Recommendations.

All size Tanks shown in preceding tables can be made up for prompt shipment, either in All-Riveted or Riveted and Welded Construction.

These Tanks can all be sent out from shops completely made-up. Write for prices on larger Tanks requiring field erection or special design.

Horizontal Storage Tanks
Information and Recommendations

Our prices on tanks include standard openings. On tanks 60 inches in diameter and larger they include one 18 inch diameter wrought steel nozzle type manhole with bolted cover as shown.

All openings are figured at $1.00 per inch of diameter, so if you require more or less than is our standard, you can figure accordingly.

Heating coils furnished if desired, at extra cost.

Combination welded-riveted and all riveted construction furnished at same prices.

Structural steel supports furnished extra, any style or height.

We recommend that nothing lighter than ¼ inch plate be used for underground storage, or in tanks over 72 inches in diameter.

Where tanks up to 72 inches in diameter are elevated on concrete piers, we recommend that the piers be at least 12 inches wide and long enough so that the tank will have a bearing surface of at least one-third of its circumference. Over 72 inches, the piers should be from 15 to 18 inches thick. If possible, there should be one pier to each course with not more than 8 feet centers, and the piers should be so arranged that they come near the ends of the tank, and so spaced that they do not cover the girth seams.

Where a tank is to be buried underground and the top of it is to be more than one foot below the surface we ask that you write us for our recommendations regarding design, etc.

We recommend that where tanks are buried underground, provision be made for draining the pit, so that water will not collect and float the tank when empty, thus breaking pipe connections.

Lancaster Storage Tanks are constructed strong enough to withstand liquid storage pressure without bracing. One-piece flat heads used.

All material best quality Class "A" Open Hearth Steel.

All rivets and seams carefully caulked or riveted and welded and tanks tested under 5 to 10 pounds air pressure.

Painted outside one coat protective paint.

All openings plugged for shipment. Cast Iron Plugs.

Tanks over 5 feet in diameter loaded with overhead cranes, blocked and rodded to car to prevent damage in transit.

We recommend that a tank should not be longer than five times its diameter.

Manhole cover can be tapped for fill pipe or any other connection, if desired. Price $1.00 per inch of diameter for extra pipe openings.

Any tanks listed here can be shipped completely made up on one car.

Capacity chart showing number of gallons per inch of height of any tank supplied by us, will be furnished on request.

Horizontal Storage Tanks

Information and Recommendations—*Continued*

As the life of a tank depends upon the care it receives, we recommend that it be painted at least once a year with a good quality protective paint.

In compiling this list, we have arranged it according to diameters. If you are cramped for space, you can find a shorter tank of greater diameter that will suit your requirements.

We have shown all sizes of tanks in two and mostly three thicknesses of shell. All State Laws are not the same and where the fire risk is greater as in congested districts, the heaviest plate is generally required.

Every LANCASTER tank carries a name plate with reference numbers on it. The detailed specifications and history of the tank are carefully preserved in our files, and if at any time in the future information is wanted about it, it can be obtained by writing to us and referring to that number.

Classification of Steels

LANCASTER TANKS can be furnished of any kind of steel generally used but are usually furnished to a definite specification of either Class A7-29 or Class A9-29 American Society for Testing Materials Specifications.

Considerable doubt as to the proper quality of steel to use in Tanks exists generally and a brief explanation of the better known specifications may be useful.

Tank Steel was for years known as the proper steel to be used in ordinary tank manufacture. While it is still used to a great extent Lancaster Iron Works long ago discarded Tank Steel, which is without definite specifications as unworthy and entirely too uncertain in physical and chemical qualities.

Flange or Boiler Steel also *Firebox Steel* are classes of steel usually specified in Boilers and Pressure Vessels, or Tanks subjected to high pressures. The A. S. M. E. Code, also many State and Insurance Regulations specify these grades.

Still Bottom and *Locomotive Fire Box* steels are specified where plates are not only subjected to pressure but also to direct heat.

Marine Steel—U. S. Navy—Hull Steel and other *Boat Steels* are all that their names imply and used only in boat manufacture.

Class "A" Steels, as they are becoming generally known, are steel plates rolled to A. S. T. M. specifications, these specifications having been revised in 1929 by the American Society for Testing Materials as follows:—

Structural Steel for Bridges A7-29

Structural Steel for Buildings A9-29

There are only slight differences in the analysis and structure of these two specifications and both have been found to work out satisfactorily in the manufacture of tanks to the highest degree. So far as strength is concerned the

Classification of Steels—*Continued*

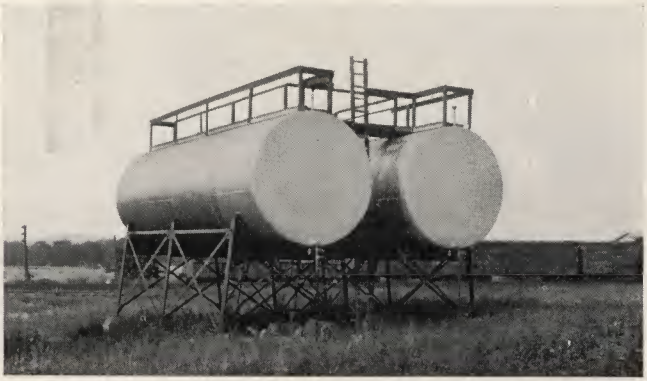
Tensile Strength is from 55,000 lbs. to 65,000 lbs. per square inch and the Class "A" Steels resemble Flange or Boiler Steel so closely, that there is no appreciable difference, as can be seen from extracts taken from typical Testing Reports covering the two steels:

Chemical Analysis					Pounds Per Square Inch	
	Carb.	Mang.	Phos.	Sulph.	Yield Point	Tensile Strength
Flange Steel	.21	.47	.015	.037	35,700	59,700
Class A Steel	.21	.48	.029	.034	37,400	64,200

These are bona fide figures and are representative of the class of steel under A. S. T. M. specifications we are recommending and using in all ordinary tank work. We prefer that customers should state for what purpose tanks are to be used, or what pressures they are to work under, if any, also what codes or laws must be observed and we will then specify and use the proper class of steel for the job.

There is no increase in the cost of Class "A" steels over steels with indefinite specifications and as they are superior in so many ways, *Lancaster* early saw the especial advantages to be obtained for the customer and has been making Class "A" Lancaster Tanks for some years.

There are distinct advantages in using various types of steels for different purposes and our Engineers will be glad to recommend and suggest the proper kinds for tanks of any description or for any purpose.



Horizontal Storage Tanks on Structural Supports
Furnished any style or height.

Copper Bearing Steel

Probably the most important contribution to the steel industry in recent years tending to retard corrosion in Smoke Stacks, Outdoor Tanks, and other classes of steel plate work subject to atmospheric influences, has been the simple addition of Copper to the molten metal in the open hearth. Exhaustive and impartial tests over a period of ten years have determined that from .25% to .50% of Copper is the proper amount to be used. No change occurs in the steel other than the effect caused by the slight addition of Copper. Copper does not segregate in the ingot like phosphorus, sulphur or carbon, but spreads equally throughout the entire heat in the open hearth.

"Steel having an admixture of from .25 to .30 percent copper is more resistent to corrosion than is steel or iron not containing copper. Copper bearing steel should be used for the steel plates in self-supporting steel stacks. The so-called *ingot irons* or *pure irons* have no advantage over structural steel for use in steel stacks."

—Structural Engineers Handbook
By Milo S. Ketchum—Dean of College of Engineering
Univ. of Illinois.

"Where the surface of steel is exposed to the atmosphere there is no question but that .15 to .30 percent of copper prolongs the life very materially.

—American Society of Testing Materials.

"Copper Bearing Steels possess good rust resisting qualities under the conditions of atmospheric corrosion."

—Massachusetts Institute of Technology.

"Sulphur in steel accelerates corrosion very markedly and sulphur oxides in the air accelerate the corrosion of steel, but Copper in steel counteracts or retards both corroding influences."

—Pittsburgh Testing Laboratory.

Practically all of the large railroads of the United States have adopted Copper bearing steel in their specifications for coal cars and tanks and have found by tests conducted by themselves that the life of steel is increased by more than 50 percent.

Lancaster Iron Works have been pioneers in recommending and manufacturing copper bearing steel Tanks, Stacks and Pipe. The first cost of tanks is only slightly increased by using copper bearing steel, but as the life is so much greater it is far cheaper in the end.

Copper in steel increases its ductility, retards corrosion and insures long wear.

Use Copper Bearing Steel

Life of Buried Steel Tanks

As the life of a buried steel tank is a pertinent subject in connection with underground tank installations, the following information from "*Fuel Oil Installations,*" published by the Associated Factory Mutual Fire Insurance Companies and which is based on the investigations and wide experience of their Inspection Department, is interesting and important.

In order to have definite facts regarding the probable life of buried steel tanks, to observe the effects of different kinds of soil upon the steel, and to note the comparative value of various protective coatings, twenty-eight steel tanks have been uncovered and examined.

The tanks inspected have been in service for periods ranging from eighteen months to twenty-six years and were buried from ten inches to nine feet below the ground level. The soil surrounding them consisted of sand, gravel, loam, clay, cinders, or mixtures of these, and sometimes contained ground water and in a few cases salt tide water.

The tanks chosen were cylindrical in shape, horizontally placed with one exception, and varied in capacity from 1100 to 22000 gallons. In only a few instances were the tanks entirely uncovered. Ordinarily, a test pit was dug large enough to expose one end and a section of the side down to the center line. The type of fill, kind of protective coating, character of corrosion, condition and thickness of the metal were noted; and in a few cases a sample of the incrustation on the tank and also of the soil was obtained for analysis.

"The life of a buried steel tank depends on the kind of protective coating, the type of back-fill, nature of ground water, depth of bury and the existence of stray electrical currents.

"Experience indicates that the best coating for buried black steel tanks or piping is red lead and linseed oil, applied carefully to a well cleaned metal surface with an outer protective coating of asphalt. Red lead and oil alone or asphalt alone give reasonably good protection if the film is unbroken.

"Steel tanks protected by paint and buried under favorable conditions should be serviceable for considerably more than thirty years. Even when buried in poor soil and damp ground, they will last for fifteen to twenty years.

"Types of soil in their order of desirability for fill around steel tanks are as follows:

"(1) Sand; (2) Gravel;(3) Clay; (4) Loam. Cinder fill has been known to cause extremely rapid corrosion and should not be allowed in the vicinity of buried steel. Coal piles should not be located over oil tanks or piping.

"Where the soil contains corrosive substances special protection may be required. This may be accomplished by back filling with moist clay well rammed, or by coating the entire tank with a shell of reinforced concrete."

Information Regarding a State Permit in Pennsylvania for the Storage of Volatile Inflammable Liquids

Secure from Bureau of Fire Protection—Pennsylvania State Police, Harrisburg, Pennsylvania, a set of "Regulations" and an application blank requiring the following information:—

Name and Location.

Size of tank in gallons.

Name of Manufacturer.

Liquid to be handled.

Material, specifications and style of construction.

Method of installation—under ground or above ground.

Construction of Vault, if used.

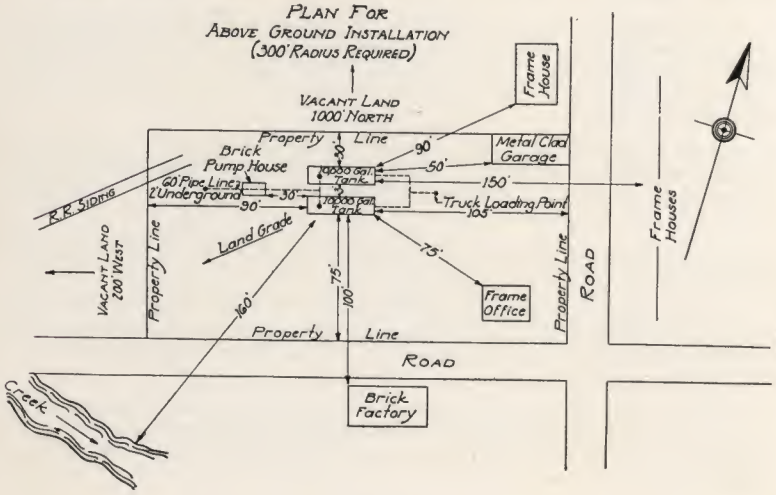
Description of Supports or Base.

Distance to nearest buildings and nearby tanks.

Number of feet below surface (3 feet required).

Ventilating arrangements, location of Fill Pipe, system of Lighting, means of Fire Extinguishing available, distance to adjoining property lines, etc.

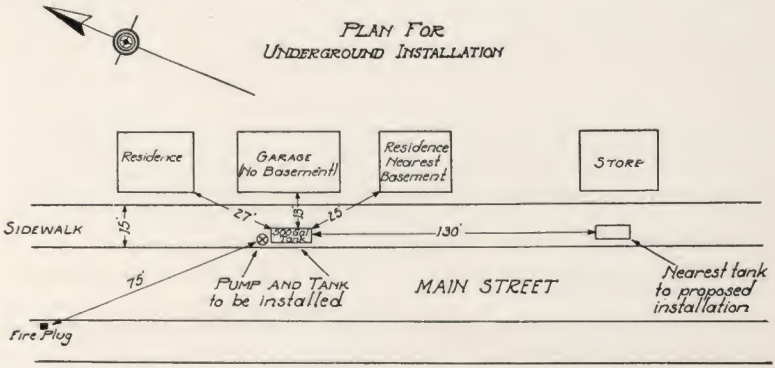
Applications are to be accompanied by Plan or Diagram similar to typical sketch shown below for Above Ground Tanks and on opposite page for underground Tanks.



Storage Tank Regulations

State Laws and Insurance Requirements in various parts of the country must be carefully adhered to when storing volatile inflammable or combustible liquids in steel tanks.

Lancaster Tanks are designed and built to conform to all existing laws and regulations, but before ordering or specifying tanks, it is advisable for customers to investigate the laws covering installation of tanks at the specified location and not only assure themselves that the laws are being complied with but also to make proper application for permit to install tanks under the necessary regulations.



In Pennsylvania, to secure a permit it is only necessary to apply to the Pennsylvania State Police, Bureau of Fire Protection, Harrisburg, Pennsylvania, and a complete set of regulations along with application blank will be furnished. Other states which have such regulations, take care of the issuing of permits in a similar way.

Lancaster Iron Works carries on hand copies of many State or Insurance regulations and will assist customers at any time to obtain the proper information and specifications as part of our regular service.

Comparison of Regulations Covering Horizontal Storage Tanks

Some regulations require heavier metal in storage tanks than others or joints with higher efficiencies and some specify heavier metal in underground tanks than for above ground tanks.

Pennsylvania Regulations require that plan or diagram covering above ground installation must be submitted showing proposed location of tank and drawing-off device, etc., distance therefrom to point of adjoining property lines in each direction; distance from all buildings on the premises, and distance

from all buildings immediately outside of the property lines, including occupancy and use of buildings indicated, and such other information as required on the application form.

As these regulations are typical of most other State requirements the following extracts from the Pennsylvania regulations issued 1929 are of general interest:

Section 7. Tanks for the storage of volatile inflammable liquids and kerosene, shall be placed outside of buildings and underground, except as otherwise provided, not less than two feet below the surface, entirely surrounded by earth well tamped in place, with a masonry foundation or base of concrete brick or stone, at least six inches thick. If impracticable to locate tanks outside of buildings, they may be buried below level of basement or cellar floor, imbedded in earth well tamped and covered by at least two feet of earth, with a base or foundation of concrete at least six inches thick, excepting that no tank used for the storage of volatile inflammable liquid will be permitted under any building not of fire-resistive construction, or where such building is used in whole or in part as a place of public assembly or habitation. Kerosene tanks shall not be placed under any buildings used for public assembly. The limit of storage permitted shall depend upon the location of tanks with respect to the building to be supplied and adjacent buildings, as follows, excepting that tanks exceeding 3000 gallons capacity will not be permitted in the fire zone of any city, borough or district, or in any other locality where such installation would constitute a dangerous hazard.

(a) Unlimited capacity if lower than the floor, basement, cellar or pit of any building within a radius of fifty feet.

(b) 20,000 gallons total capacity if lower than the floor, basement, cellar or pit of any building within thirty feet radius.

(c) 5,000 gallons total capacity if lower than the floor, basement, cellar or pit of any building within twenty feet radius.

(d) 1,500 gallons total capacity if lower than the floor, basement, cellar or pit of any building within ten feet radius.

(e) 500 gallons if not lower than every floor, basement, cellar or pit of any building within ten feet, in which case it must be entirely encased in six inches of concrete.

(f) Where tanks are used for kerosene, exclusively, the capacities may be doubled and the distances reduced one-half in paragraphs, (c), (d), and (e) in this section.

(g) Tanks not exceeding 60 gallons capacity, where same would be so located as not to permit vehicular traffic passing over the ground surrounding same, may be installed outside of buildings without base as otherwise required in this section, at a depth of not less than 18 inches below the surface.

Section 8. Tanks may be placed in vaults where air space therein shall be filled in and solidly tamped with earth or sand.

Section 9. Where impracticable to place tanks underground, they may be placed outside aboveground under the following direction, provided that aboveground tanks shall be restricted in fire zones, and shall not constitute a hazard where erected:

Thickness of Steel Plates in Horizontal Storage Tanks as Required in Pennsylvania

Capacity (Gallons)	*Minimum Thickness of Material*
1 to 350	16 gauge—equivalent to $\frac{1}{16}$"
351 to 560	14 gauge—equivalent to $\frac{5}{64}$"
561 to 1,100	12 gauge—equivalent to $\frac{7}{64}$"
1,101 to 4,000	7 gauge—equivalent to $\frac{3}{16}$"
4,001 to 10,500	$\frac{1}{4}$"
10,501 to 20,000	$\frac{5}{16}$"
20,001 to 30,000	$\frac{3}{8}$"

Thickness of Steel Plates in Horizontal Storage Tanks as Required by the Underwriters' Laboratories—Established and Maintained by the National Board of Fire Underwriters

Capacity and Size—Horizontal Tanks:

1. Horizontal tanks shall not exceed the maximum capacities, diameters, or lengths for the corresponding gauges of metal outlined in the following table, except as noted below.

U. S. S. Gauge Metal	Approx. Thickness Inches	Maximum Capacity U. S. Gal.	Maximum Diameter Inches	Maximum Length of Shell Feet
16	$\frac{1}{16}$	285	38	8
14	$\frac{5}{64}$	560	46	11
12	$\frac{7}{64}$	1,100	56	14
7	$\frac{3}{16}$	4,000*	84*	22*
3	$\frac{1}{4}$	12,000*	126*	32*
0	$\frac{5}{16}$	20,000*	132*	42*
000	$\frac{3}{8}$	30,000*	132*	50*

*To take care of miscalculations and mistakes in fabrication, for tanks made of No. 7 or heavier gauge metal, a tolerance of 10 per cent in capacity and a tolerance of 5 per cent in either the diameter or the length will be permitted. This does not mean that tanks made of No. 7 or heavier gauge stock should be intentionally designed to have capacities, diameters, or lengths in excess of the nominal maximums designated above for such stocks.

—*Underwriter's Laboratories*

Department of Public Safety
Commonwealth of Massachusetts

(Extract from Laws and Regulations—1929)

Horizontal Tanks

Section 4. The minimum thickness of shell plates used in horizontal tanks shall be $\frac{1}{4}''$ when the tank does not exceed 10′ 6″ in diameter. When a tank exceeds 10′ 6″ in diameter the minimum thickness of shell plates shall be $\frac{5}{16}''$. When a tank is over 24′ in length the minimum thickness of shell plates shall be $\frac{5}{16}''$. When the heads of a horizontal tank are not dished to the proper radius they shall be stiffened with channel or angle irons securely riveted to the heads. The heads shall be at least the same thickness as shell.

Riveting

Section 5. All seams shall be substantially riveted; when the plate does not exceed $\frac{5}{16}''$ thick the minimum size of rivets after driving shall be $\frac{11}{16}''$, and the maximum pitch of rivets for single riveting shall be $2\frac{1}{8}''$. The maximum pitch of rivets for double riveting shall be $2\frac{5}{8}''$. When the thickness of shell plates exceeds $\frac{5}{16}''$ the size of the rivets and pitch of rivets may be increased in such a manner as to insure substantial caulking. The rivet holes shall be fair; and the rivets shall be driven so as to fill the rivet holes and form substantial heads on the rivets. The caulking edges may be caulked and made tight, or they may be electrically welded in such a manner that, in case of a leak, the welding may be caulked. The use of a drift pin is prohibited in lining up rivet holes. The distance from center of rivet holes to edge of plate must be at least $1\frac{1}{2}$ times the diameter of rivet holes.

Computing Strength

Section 12. When the fluid to be stored in any tank has a specific gravity of *one* or less, the specific gravity of *one* shall be used and the strength of tank shall be computed on a factor of safety of *three*. When the fluid to be stored in any tank has a specific gravity of more than *one*, that specific gravity shall be used, and the strength of the tank shall be computed on a factor of safety of *four*.

Formula for Computing Strength of Tank

Section 13.

$$\frac{TS \times T \times eff}{R \times FS}$$

TS = Tensile strength of shell plates.
T = Thickness of shell plates in inches.
eff = Efficiency of longitudinal riveted seams.
R = ½ Diameter of tank in inches.
FS = Factory of safety.

It will be noted that the Massachusetts regulations are somewhat stricter than the Underwriter's specifications and the Pennsylvania regulations and as the Pennsylvania laws are typical of most states this brief summary should give customers an idea as to their general requirements.

City of New York

Municipal Rules in New York City covering the construction of Horizontal Storage Tanks are issued by the Board of Standards and Appeals and the Fire Commissioner and the Superintendent of Buildings are the administrative officials.

Material and Construction of Tanks for the Storage of Fuel Oil

Section 1. Cylindrical Tanks (except vertical tanks located outside of buildings above ground).

(a) All tanks for the storage of fuel oil shall be built of steel plates made by the open hearth process and known to the trade as "tank steel." Such plates shall be free from physical imperfections, such as laminations cracks, etc. All steel must be new, in good condition and free from rust. The thickness of steel required and the size and spacing of rivets shall be as stated in the table given below.

(b) All tanks must be welded, riveted and caulked, or riveted and welded. Flanges or other pipe connections may be welded. All caulking shall be done with round nose tools and without injury to the plates.

(c) Thickness of cylindrical tanks:

Tanks 36 in. in diameter and less—¼ in. shell, ¼ in. heads.

Tanks 37 to 72 in. in diameter—¼ in. shell, 5/16 in. heads.

Tanks 73 to 120 in. in diameter—5/16 in. shell, ⅜ in. heads.

Tanks over 120 inches in diameter to be of ⅜ in. steel and to be stiffened by angle rings or equivalent members so as to retain their cylindrical form.

(d) All cylindrical tanks shall preferably be built with dished heads. Should flat heads be used they must be braced in the same manner as described for the bracing of flat sides of rectangular tanks.

(e) Diameter and spacing of rivets:

Riveting in single lap seams shall not exceed a pitch as follows:

In shell ¼ in. thick, ⅝ in. diameter rivets 2¼ in. pitch.

In shell 5/16 in. thick, ⅝ in. diameter rivets 2⅜ in. pitch.

In shell ⅜ in. thick, ¾ in. diameter rivets 2½ in. pitch.

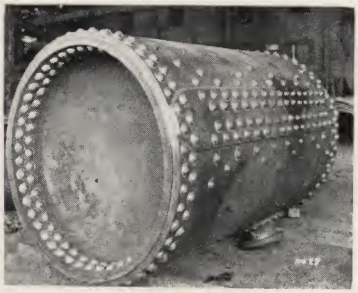
Section 4. Outside of Buildings Below Ground.

(a) Tanks shall be buried underground below the level of any piping to which they may be connected, with the tops of the tanks not less than two (2) feet below the surface of the ground; or, in lieu of the two (2) foot cover of earth, tanks may be buried under twelve (12) inches of earth, well tamped, covered by at least six (6) inches of concrete; which shall extend at least one foot beyond the horizontal outline of tanks in all directions. Where necessary to prevent floating, tanks shall be securely anchored.

(b) Tanks shall be set on concrete or metal cradles which shall be placed on firm soil and surrounded with soft earth or sand well tamped. Tanks shall be completely encased with six (6) inches of concrete when buried in soil the nature of which would make additional protection necessary.

Pressure Storage Tanks for Water, Air and Chemicals

Specifications of Standard Capacities
115 to 23,600 Gallons
Pages 27 to 32 inclusive



Specially Designed
Tanks for
High Pressures
Built to Specifications

Standard 15,000 Gallon Tank
8 ft. dia. x 40 ft. long—Riveted Construction

Pressure Tanks

	Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds	Working Pressure F. S. = 4 Lbs.
			Shell	Heads			
S. R.	24″	5′0″	3/16″	3/16″	115	335	119
	*24″	5′0″	3/16″	1/4″	115	370	119
	24″	5′0″	1/4″	1/4″	115	455	170
	24″	6′0″	3/16″	3/16″	140	395	119
	*24″	6′0″	3/16″	1/4″	140	430	119
	24″	6′0″	1/4″	1/4″	140	530	170
	24″	8′0″	3/16″	3/16″	190	495	119
	*24″	8′0″	3/16″	1/4″	190	530	119
	24″	8′0″	1/4″	1/4″	190	655	170
S. R.	30″	5′0″	3/16″	3/16″	185	455	95
	*30″	5′0″	3/16″	1/4″	185	505	95
	30″	5′0″	1/4″	1/4″	185	610	136
	30″	6′0″	3/16″	3/16″	220	535	95
	*30″	6′0″	3/16″	1/4″	220	585	95
	30″	6′0″	1/4″	1/4″	220	705	136
	30″	8′0″	3/16″	3/16″	295	640	95
	*30″	8′0″	3/16″	1/4″	295	690	95
	30″	8′0″	1/4″	1/4″	295	840	136
	30″	10′0″	3/16″	3/16″	365	780	95
	*30″	10′0″	3/16″	1/4″	365	830	95
	30″	10′0″	1/4″	1/4″	365	1025	136
S. R.	36″	6′0″	3/16″	3/16″	315	650	79
	*36″	6′0″	3/16″	5/16″	315	790	79
	36″	6′0″	1/4″	5/16″	315	930	113
	36″	8′0″	3/16″	3/16″	425	830	79
	*36″	8′0″	3/16″	5/16″	425	970	79
	36″	8′0″	1/4″	5/16″	425	1155	113
	36″	10′0″	3/16″	3/16″	525	1010	79
	*36″	10′0″	3/16″	5/16″	525	1150	79
	36″	10′0″	1/4″	5/16″	525	1395	113
	36″	12′0″	3/16″	3/16″	530	1150	79
	*36″	12′0″	3/16″	5/16″	630	1290	79
	36″	12′0″	1/4″	5/16″	630	1580	113

Quality in tanks cannot be acquired by words nor a coat of black paint. It must be present from the beginning.

*Standard sizes carried in stock for prompt shipment.

Pressure Tanks

	Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds	Working Pressure F. S. = 4 Lbs.
			Shell	Heads			
S. R.	36″	14′0″	3/16″	3/16″	735	1360	79
S. R.	*36″	14′0″	3/16″	5/16″	735	1500	79
S. R.	36″	14′0″	1/4″	5/16″	735	1840	113
S. R.	42″	6′0″	3/16″	3/16″	430	770	68
S. R.	*42″	6′0″	1/4″	5/16″	430	1100	97
S. R.	42″	6′0″	5/16″	5/16″	430	1240	78
S. R.	42″	8′0″	3/16″	3/16″	575	1000	68
S. R.	*42″	8′0″	1/4″	5/16″	575	1370	97
S. R.	42″	8′0″	5/16″	5/16″	575	1560	78
S. R.	42″	10′0″	3/16″	3/16″	720	1230	68
S. R.	*42″	10′0″	1/4″	5/16″	720	1640	97
S. R.	42″	10′0″	5/16″	5/16″	720	1885	78
S. R.	42″	12′0″	3/16″	3/16″	865	1460	68
S. R.	*42″	12′0″	1/4″	5/16″	865	1910	97
S. R.	42″	12′0″	5/16″	5/16″	865	2210	78
S. R.	42″	14′0″	3/16″	3/16″	1000	1690	68
S. R.	*42″	14′0″	1/4″	5/16″	1000	2180	97
S. R.	42″	14′0″	5/16″	5/16″	1000	2530	78
S. R.	42″	16′0″	3/16″	3/16″	1150	1920	68
S. R.	*42″	16′0″	1/4″	5/16″	1150	2455	97
S. R.	42″	16′0″	5/16″	5/16″	1150	2855	78
S. R.	48″	8′0″	3/16″	3/16″	750	1100	59
S. R.	*48″	8′0″	1/4″	3/8″	750	1700	85
S. R.	48″	8′0″	5/16″	3/8″	750	1920	85
S. R.	48″	10′0″	3/16″	3/16″	950	1375	59
S. R.	*48″	10′0″	1/4″	3/8″	950	1985	85
S. R.	48″	10′0″	5/16″	3/8″	950	2260	85
S. R.	48″	12′0″	3/16″	3/16″	1100	1650	59
S. R.	*48″	12′0″	1/4″	3/8″	1100	2275	85
S. R.	48″	12′0″	5/16″	3/8″	1100	2595	85
S. R.	48″	14′0″	3/16″	3/16″	1300	1910	59
S. R.	*48″	14′0″	1/4″	3/8″	1300	2560	85
S. R.	48″	14′0″	5/16″	3/8″	1300	2935	85

Tanks and Steel Plate work of every description look so much alike that the intention and the ability of the maker form the only sound basis for preference and selection.

*Standard sizes carried in stock for prompt shipment.

Pressure Tanks

	Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds	Working Pressure F. S. = 4
			Shell	Heads			Lbsl
S. R.	48″	16′0″	3/16″	3/16″	1500	2180	59
	*48″	16′0″	1/4″	3/8″	1500	2850	85
	48″	16′0″	5/16″	3/8″	1500	3275	85
	48″	20′0″	3/16″	3/16″	1880	2450	59
	*48″	20′0″	1/4″	3/8″	1880	3425	85
	48″	20′0″	5/16″	3/8″	1880	3950	85
	48″	22′0″	3/16″	3/16″	2050	2720	59
	*48″	22′0″	1/4″	3/8″	2050	3715	85
	48″	22′0″	5/16″	3/8″	2050	4290	85
	58″	24′0″	3/16″	3/16″	2260	3000	59
	*48″	24′0″	1/4″	3/8″	2260	4000	85
	48″	24′0″	5/16″	3/8″	2260	4630	85
D. R.	60″	14′0″	3/16″	1/4″	2050	2430	70
	*60″	14′0″	5/16″	3/8″	2050	3800	103
	60″	14′0″	3/8″	7/16″	2050	4520	120
	60″	16′0″	3/16″	1/4″	2350	2730	70
	*60″	16′0″	5/16″	3/8″	2350	4310	103
	60″	16′0″	3/8″	7/16″	2350	5120	120
	60″	18′0″	3/16″	1/4″	2640	3030	70
	*60″	18′0″	5/16″	3/8″	2640	4815	103
	60″	18′0″	3/8″	7/16″	2640	5720	120
	60″	20′0″	3/16″	1/4″	2940	3330	70
	*60″	20′0″	5/16″	3/8″	2940	5325	103
	60″	20′0″	3/8″	7/16″	2940	6320	120
	60″	22′0″	3/16″	1/4″	3230	3630	70
	*60″	22′0″	5/16″	3/8″	3230	5835	103
	60″	22′0″	3/8″	7/16″	3230	6925	120
	*60″	24′0″	3/16″	1/4″	3525	3930	70
	*60″	24′0″	5/16″	3/8″	3525	6345	103
	60″	24′0″	3/8″	7/16″	3525	7525	120
	60″	28′0″	3/16″	1/4″	4100	4530	70
	60″	28′0″	5/16″	3/8″	4100	6850	103
	60″	28′0″	3/8″	7/16″	4100	8125	120
	60″	30′0″	3/16″	1/4″	4400	4830	70

The purchaser is always sure of good work when he knows that the manufacturer habitually means to make a worthy product and has the experience, knowledge, skill and resources to do it.

*Standard sizes carried in stock for prompt shipment.

Pressure Tanks

	Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds	Working Pressure F. S. = 4
			Shell	Heads			Lbs.
D. R.	*60″	30′0″	5/16″	3/8″	4400	7365	103
D. R.	60″	30′0″	3/8″	7/16″	4400	8725	120
D. R.	72″	8′0″	3/16″	1/4″	1690	2320	53
D. R.	*72″	8′0″	5/16″	3/8″	1690	3325	86
D. R.	72″	8′0″	3/8″	7/16″	1690	3930	101
D. R.	72″	12′0″	3/16″	1/4″	2540	3030	53
D. R.	*72″	12′0″	5/16″	3/8″	2540	4340	86
D. R.	72″	12′0″	3/8″	7/16″	2540	5140	101
D. R.	72″	16′0″	3/16″	1/4″	3385	3690	53
D. R.	*72″	16′0″	5/16″	3/8″	3385	5350	86
D. R.	72″	16′0″	3/8″	7/16″	3385	6340	101
D. R.	72″	18′0″	3/16″	1/4″	3805	4025	53
D. R.	*72″	18′0″	5/16″	3/8″	3805	5855	86
D. R.	72″	18′0″	3/8″	7/16″	3805	6940	101
D. R.	72″	24′0″	3/16″	1/4″	5080	5020	53
D. R.	*72″	24′0″	5/16″	3/8″	5080	7365	86
D. R.	72″	24′0″	3/8″	7/16″	5080	8730	101
D. R.	72″	30′0″	3/16″	1/4″	6345	6015	53
D. R.	*72″	30′0″	5/16″	3/8″	6345	9050	86
D. R.	72″	30′0″	3/8″	7/16″	6345	10730	101
D. R.	72″	36′0″	3/16″	1/4″	7600	7020	53
D. R.	*72″	36′0″	5/16″	3/8″	7600	10565	86
D. R.	72″	36′0″	3/8″	7/16″	7600	12530	101
D. R.	84″	18′0″	1/4″	1/4″	5180	5685	59
D. R.	*84″	18′0″	5/16″	3/8″	5180	6975	74
D. R.	84″	18′0″	3/8″	7/16″	5180	8170	86
D. R.	84″	24′0″	1/4″	1/4″	6910	7245	59
D. R.	*84″	24′0″	5/16″	3/8″	6910	8700	74
D. R.	84″	24′0″	3/8″	7/16″	6910	10310	86
D. R.	84″	28′0″	1/4″	1/4″	8060	8285	59
D. R.	*84″	28′0″	5/16″	3/8″	8060	10000	74
D. R.	84″	28′0″	3/8″	7/16″	8060	11860	86
D. R.	84″	30′0″	1/4″	1/4″	8635	8805	59

Lancaster's name has become synonymous with Tanks and Steel Plate Construction.

*Standard sizes carried in stock for prompt shipment.

Pressure Tanks

	Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds	Working Pressure F. S. = 4
			Shell	Heads			Lbsl
D. R.	*84″	30′0″	5/16″	3/8″	8635	10400	74
	84″	30′0″	3/8″	7/16″	8635	12340	86
	84″	36′0″	1/4″	1/4″	10360	10365	59
	*84″	36′0″	5/16″	3/8″	10360	12400	74
	84″	36′0″	3/8″	7/16″	10360	14720	86
D. R.	96″	16′0″	1/4″	5/16″	6015	6515	52
	*96″	16′0″	5/16″	3/8″	6015	7515	65
	96″	16′0″	3/8″	1/2″	6015	9290	76
	96″	18′0″	1/4″	5/16″	6770	7130	52
	*96″	18′0″	5/16″	3/8″	6770	8150	65
	96″	18′0″	3/8″	1/2″	6770	10060	76
	96″	20′0″	1/4″	5/16″	7520	7750	52
	*96″	20′0″	5/16″	3/8″	7520	8850	65
	96″	20′0″	3/8″	1/2″	7520	10920	76
	96″	24′0″	1/4″	5/16″	9020	8985	52
	*96″	24′0″	5/16″	3/8″	9020	10200	65
	96″	24′0″	3/8″	1/2″	9020	12550	76
	96″	28′0″	1/4″	5/16″	10530	10225	52
	*96″	28′0″	5/16″	3/8″	10530	11515	65
	96″	28′0″	3/8″	1/2″	10530	14140	76
	96″	30′0″	1/4″	5/16″	11280	10845	52
	*96″	30′0″	5/16″	3/8″	11280	12140	65
	96″	30′0″	3/8″	1/2″	11280	14895	76
	96″	32′0″	1/4″	5/16″	12030	11460	52
	*96″	32′0″	5/16″	3/8″	12030	12880	65
	96″	32′0″	3/8″	1/2″	12030	15790	76
	96″	36′0″	1/4″	5/16″	13540	12700	52
	*96″	36′0″	5/16″	3/8″	13540	14140	65
	96″	36′0″	3/8″	1/2″	13540	17320	76
	96″	40′0″	1/4″	5/16″	15040	13465	52
	*96″	40′0″	5/16″	3/8″	15040	15540	65
	96″	40′0″	3/8″	1/2″	15040	19010	76
T. R.	108″	20′0″	1/4″	5/16″	9520	8555	48
	*108″	20′0″	5/16″	3/8″	9520	10095	60

Lancaster knows how to combine good shop practice with sound engineering principles, and it can make a very clear estimate of the cost and the time necessary to complete a job.

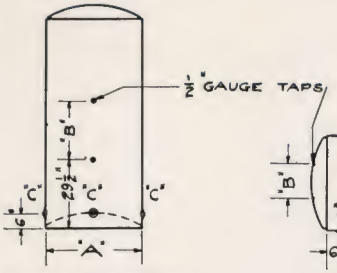
*Standard sizes carried in stock for prompt shipment.

Pressure Tanks

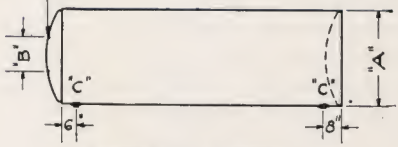
	Diameter	Length	Thickness		Capacity in Gallons	Weight Pounds	Working Pressure F. S. = 4
			Shell	Heads			Lbs.
T. R.	108″	20′0″	3/8″	1/2″	9520	12480	69
	108″	24′0″	1/4″	5/16″	11400	9840	48
	*108″	24′0″	5/16″	3/8″	11400	11585	60
	108″	24′0″	3/8″	1/2″	11400	14275	69
	108″	28′0″	1/4″	5/16″	13300	11125	48
	*108″	28′0″	5/16″	3/8″	13300	13125	60
	108″	28′0″	3/8″	1/2″	13300	16155	59
	108″	32′0″	1/4″	5/16″	15200	12405	48
	*108″	32′0″	5/16″	3/8″	15200	14615	60
	108″	32′0″	3/8″	1/2″	15200	17955	69
	108″	36′0″	1/4″	5/16″	17100	13690	59
	*108″	36′0″	5/16″	3/8″	17100	16130	48
	108″	36′0″	3/8″	1/2″	17100	19795	60
	108″	40′0″	1/4″	5/16″	19040	14970	69
	*108″	40′0″	5/16″	3/8″	19040	17610	48
	108″	40′0″	3/8″	1/2″	19040	21580	60
T. R.	120″	20′0″	1/4″	3/8″	11800	10020	69
	*120″	20′0″	5/16″	3/8″	11800	11340	48
	120″	20′0″	3/8″	1/2″	11800	14055	43
	120″	24′0″	1/4″	3/8″	14100	11385	53
	*120″	24′0″	5/16″	3/8″	14100	12965	62
	120″	24′0″	3/8″	1/2″	14100	16025	43
	120″	28′0″	1/4″	3/8″	16450	12770	53
	*120″	28′0″	5/16″	3/8″	16450	14615	62
	120″	28′0″	3/8″	1/2″	16450	18010	43
	120″	32′0″	1/4″	3/8″	18800	14133	53
	*120″	32′0″	5/16″	3/8″	18800	16245	62
	120″	32′0″	3/8″	1/2″	18800	19980	43
	120″	36′0″	1/4″	3/8″	21000	15520	53
	*120″	36′0″	5/16″	3/8″	21000	17930	62
	120″	36′0″	3/8″	1/2″	21000	22025	43
	120″	40′0″	1/4″	3/8″	23600	16860	53
	*120″	40′0″	5/16″	3/8″	23600	19560	62
	120″	40′0″	3/8″	1/2″	23600	24000	43

Lancaster Quality has its source in the organization which designs and fabricates the products.

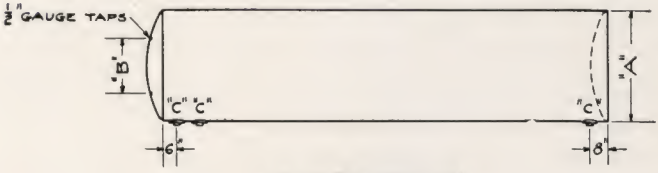
*Standard sizes carried in stock for prompt shipment.



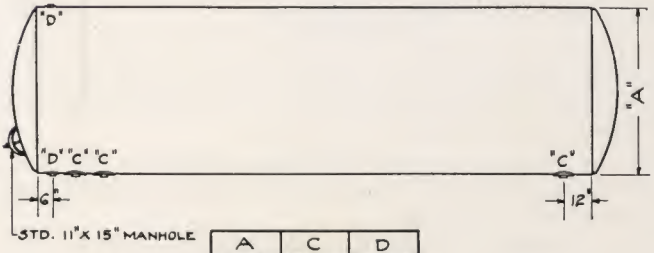
A	B	C
24" DIA.	25¼"	1" DIA.
30" "	25¼"	1" "
36" "	25¼"	1¼" "



A	B	C
24" DIA.	15¼"	1" DIA.
30" "	15¼"	1" "



A	B	C
36" DIA.	15¼"	1¼" DIA.
42" "	19¼"	1½" "
48" "	25¼"	2" "



A	C	D
5' DIA.	3" DIA.	1" DIA.
6' "	4" "	1" "
7' "	5" "	1" "
8' "	6" "	1" "
9' "	6" "	1" "
10' "	6" "	1" "

Diagram showing size and location of Openings in L. I. W. Standard Pressure Tanks

Information About Our Standard Pressure Tanks

We have shown most sizes of tanks in three thicknesses of shell.

The first or lightest construction is for storage purposes where not more than 25 to 50 lbs. pressure is required.

The intermediate specifications (marked with a star *) are our standard pressure tanks and in the majority of sizes are good for at least 85 lbs. working pressure on a Factor of Safety of Four (4).

The third set of specifications cover tanks of heavier construction, both for greater pressures and for longer service as in acid storage or where the water is particularly hard on the metal.

We also build larger and heavier tanks to work under very high pressures or extreme conditions.

On page 33 you will note a diagram showing size and location of openings in Standard Pressure Tanks. These are really standard pneumatic tank tappings. Our prices include these standard openings. Where special openings are required, you can figure $1.00 an inch of diameter.

All tanks up to and including 48″ in diameter have one head backed in and no manhole unless specially ordered.

All tanks 60″ in diameter and larger have both heads convex, and a standard 11″ x 15″ boiler manhole in one head.

The working capacity of a pressure tank is about two-thirds of its rated capacity. All pressure tanks are tested to a point 25% above the desired working pressure.

All tanks have single riveted girth seams, longitudinal seams are single, double or triple riveted, except where extra high working pressure is used and then special riveting is used as required. Button head steel boiler rivets used.

Tanks are built of class "A" steel, except in the case of very high working pressures or where heat is to be applied, and special quality steel is necessary.

All the heads are dished to a spherical radius equal to the diameter of the tank and make a wonderful appearance. They have been dished by the spinning method as against being pressed.

All openings plugged for shipment using C. I. Pipe Plugs.

Tanks over 5′ in diameter loaded with overhead cranes, blocked and rodded to car to prevent damage in transit.

The largest diameter tank that can be shipped completely made up on one car is approximately 10′6″ diameter by 40′ long.

Useful Information

TO FIND:

The circumference of a circle multiply diameter by 3.1416.

The diameter of a circle multiply circumference by .31831.

The area of a circle multiply square of diameter by .7854.

Doubling the diameter of a circle increases its area four times.

The side of an equal square multiply diameter by .8862.

A gallon of water (U. S. Standard) weighs 8⅓ lbs. and contains 231 cubic inches.

A cubic foot of water contains 7.48 gallons, 1728 cubic inches, and weighs 62.4 lbs.

Surface of sphere = circumference x diameter.

Surface of sphere = diameter^2 x 3.1416.

Surface of sphere = circumference^2 x .3183.

Volume of sphere = surface x $\frac{1}{6}$ diameter.

Volume of sphere = diameter^3 x .5236.

Volume of sphere = radius^3 x 4.1888.

Volume of sphere = circumference^3 x .016887.

To find the pressure in pounds per square inch of a column of water multiply the height of the column in feet by .434.

Steam rising from water at its boiling point (212 degrees) has a pressure equal to the atmosphere (14.7 lbs. to the square inch).

A standard horse power: The evaporation of 30 lbs. of water per hour from a feed water temperature of 100 degrees F. into steam at 70 lbs. gauge pressure. (Equivalent to 34½ lbs. from and at 212 degrees Fahr.)

TO FIND THE CAPACITY OF A TANK IN GALLONS

To find the capacity of any style tank: determine its contents in cu. inches and multiply by .004329 and the result will be in U. S. gallons.

For figuring capacity of cylindrical tanks having flat heads, square the diameter (inches), multiply by the length (inches) and multiply by .0034; the result will be in U. S. gallons.

Capacity in gallons of hemispherical tank bottom = 15.665 x r^3.

Area in square feet of hemispherical tank bottom = 1.57 x d^2.

Useful Information—*Continued*

TO DETERMINE THE THICKNESS OF BOILER SHELL:

$$T = \frac{P \times R \times F.S.}{T.S. \times E}$$

P = Maximum allowable working pressure in pounds per square inch.
T. S. = Tensile strength of shell plates, in pounds per square inch of cross section.
E = Efficiency of longitudinal joint or ligament between tubes holes, whichever is the least.
R = Radius = one half (½) the inside diameter of the outside course of the shell or drum.
F. S. = Factor of Safety (generally considered to be 5).
T = Minimum thickness of shell plates in inches.

TO DETERMINE THE SHELL THICKNESS OF STAND PIPES, STORAGE TANKS, ETC.

$$T = \frac{2.6 \times H \times D}{S \times E}$$

H = Distance down from water surface.
D = Diameter of tank.
S = Unit stress—assumed as 12,000 lbs. to 15,000 lbs. per square inch.
E = Efficiency, which depends on the design of the vertical joints, and should vary from 65% to 95%.

CONCRETE WALLS OR PIERS

The proper portion of ingredients required for supports for tanks is:

1 Cement, 2 Sand, 5 Stone

The ingredients required for 1 cubic yard of rammed concrete using stone 2½" and under are:

Cement 1.26 bbls.
Sand .48 cu. yd.
Stone .96 cu. yd.
1 cu. yd. Sand = 1.41 Tons
1 cu. yd. Stone = 1.2 Tons

Care should be taken that concrete in supporting walls or piers is thoroughly set and hardened before placing loads on same.

Liquid Measure—United States Only

Cubic Inch	Pints	Quarts	Gallons	Barrels	Hogshead
28.875	1.	0.5	0.125	0.003968	
57.75	2.	1.	0.25	0.007937	
231.	8.	4.	1.	0.031746	
7276.5	252.	126.	31.5	1.	0.5
14553.0	504.	252.	63.	2.	1.

The British Imperial gallon = 1.20032 U. S. gallons.

The United States standard unit for liquid measure is the gallon = 231 cu. in. = 8.33888 pounds, avoirdupois, of distilled water at 62° Fahr.

The English standard is the Imperial gallon = 277.2738 cu. in. = 10 pounds, avoirdupois, of distilled water at 62° Fahr.

Weights of Oils and Other Liquids

As most storage tanks contain oils, water or other well-known liquids, we are appending a table of needed information covering the general line of liquids.

Table of Weights

	Average Specific Gravity	Lbs. in 1 Gal.	Lbs. in. 1 Cu. Ft
Alcohol 90%	.8228	6.85	51.43
Alcohol 95%	.8089	6.74	50.56
Asphaltum	1.4	11.68	87.3
Castor Oil	.9639	8.03	60.24
Cotton Seed Oil	.9302	7.75	58.14
Creosote Oil	1.07	8.94	66.8
Fish Oil	.9205	7.67	57.53
Gasoline	.6511	5.42	40.69
Kerosene Oil	.8000	6.66	50.00
Lard Oil	.9175	7.64	57.34
Linseed Oil, boiled	.9411	7.84	58.81
Linseed Oil, raw	.9299	7.75	58.12
Molasses (crude)	1.458	12.17	91.00
Muriatic Acid (HCl)	1.201	10.03	75.00
Naphtha	.717	6.00	44.88
Neatsfoot Oil	.9142	7.62	57.14
Nitric Acid (HNO_3) 91%	1.50	12.57	94.00
Petroleum (crude)	.88	7.36	55.00
Petroleum (refined)	.81	6.69	50.00
Pitch	1.07 to 1.15	9.23	69.00
Snow (fresh fallen)	.125	1.07	8.00
Sperm Oil	.8815	7.34	55.09
Sulphuric Acid (H_2SO_4) 87%	1.80	14.98	112.00
Tar	1.2	10.03	75.00
Water	1.000	8.33	62.50

Steel Plate Extras

Rectangular plates, tank steel ¼" thick and over on thinnest edge 100 inches wide and under, down to, but not including, 6 inches wide, are Base.

All prices based on carloads.

Allowable overweight, for rectangular plates, whether plates are ordered to gauge or weight, to be governed by the Standard Specifications of the Association of American Steel Manufacturers.

All sketches, including circles, are invoiced at actual weight and are not subject to weight tolerances applying to rectangular plates.

Width Extras—All Plates Rectangular or Otherwise

One-quarter inch thick and heavier, but not less than 11 pounds per square foot, if ordered to weight.

Over 100 to and including 110 inches	.05c
Over 110 to and including 115 inches	.10c
Over 115 to and including 120 inches	.15c
Over 120 to and including 125 inches	.25c
Over 125 to and including 130 inches	.50c
Over 130 to and including 140 inches	.75c
Over 140 to and including 155 inches	1.00c
Over 155 to and including 170 inches	1.25c
Over 170 to and including 185 inches	1.50c
Over 185 to and including 195 inches	2.00c
Plates less than ¼-inch or lighter than 11 pounds per square foot.	
Over 72 to and including 84 inches	.10c
Over 84 to and including 96 inches	.20c
Over 96 to and including 100 inches	.30c

Gauge Extras

Gauges lighter than ¼ inch and including 3/16 inch on thin edge up to 72" wide inclusive	.20c
Gauges lighter than 3/16 inch to and including No. 7 and No. 8	.30c
Gauges lighter than No. 8 to and including No. 9 and No. 10	.40c
Gauges lighter than No. 10 to and including No. 11 and No. 12	.50c
Gauges lighter than No. 12 to and including No. 13 and No. 14	.60c

Quality Extras

Pressing steel	.10c
Flange steel (boiler grade)	.15c
Ordinary firebox steel	.20c
Stillbottom steel	.30c
Locomotive firebox steel	.50c
Marine steel	1.50c
Hull materials subject to U. S. Navy Dept. specifications for medium or soft steel	.10c
High tensile hull steel subject to U. S. navy department or equivalent specifications	1.00c

Steel Plate Extras

Quality Extras—*Continued*

Boiler steel subject to U. S. navy department specifications, classes A-B.. 1.50c
Hull plates to hull specifications, required to stand cold flanging, take extra for flange steel.

INSPECTION

Mill inspection ..... No extra
Charges for other inspection, such as Lloyd's or American bureau of shipping, will be made by inspection bureau direct to buyer.

CUTTING—LENGTH OR DIAMETER
All Plates, Rectangular or Otherwise

Three feet and over up to published limit of length, but not over 80 feet. No extra
Under 3 feet to 2 feet inclusive ..... .25c
Under 2 feet to 1 foot inclusive ..... .50c
Under 1 foot 1.55c
Over 80 feet to 100 feet inclusive ..... .10c
Over 100 feet add .25c plus .05c for every additional 2 feet or fraction thereof.

Regular Sketches

With not more than four straight cuts.
(Including straight taper plates)
Additional extra ..... .20c

Irregular Sketches

With not more than four straight cuts.
(Sketches cannot be sheared with re-entrant angles)
Additional extra ..... .50c

Circles

Additional extra ..... .50c
Half circles take circle extras.
Sketches sheared to a radius take circle extras.

Special

Torch cutting, 2½c per square inch.
Sketches or circles over 100 inches in width or diameter take width extras in addition to sketch or circle extras.
All sketches, regular, irregular, circular, semicircular or special with greatest dimension under 3 feet, take extras for cutting to length in addition to sketch or circle extra.

Weights of Steel Sheets and Plates

Estimated Weight by Standard Gauges

No. of Gauge or Thickness of Sheet	Approximate Thickness in Inches				Weight per Square Foot in Pounds					
	U. S. Standard adopted by U. S. Gov't. July 1, 1893		Stubb's or Birmingham Wire Gauge	American or Brown & Sh'rpe's	U. S. Standard	Mills Standard	Birmingham Wire Gauge		American or Brown & Sharpe's	
	Fractions	Decimals	Decimals	Decimals	Steel	Steel	Steel	Iron	Steel	Iron
7-0's	1/2	.5	....	....	20.00	20.4	.....	.....	.....	.....
6-0's	15/32	.468	....	....	18.75	19.125	.....	.....	.....	.....
7-0's	7/16	.437	....	....	17.50	17.85	.....	.....	.....	.....
0000	13/32	.406	.454	.46	16.25	16.575	18.46	18.22	18.77	18.40
000	3/8	.375	.425	.409	15.	15.30	17.28	17.05	16.71	16.38
00	11/32	.343	.38	.364	13.75	14.025	15.45	15.25	14.88	14.59
0	5/16	.312	.34	.324	12.50	12.75	13.82	13.64	13.26	13.00
1	9/32	.281	.30	.289	11.25	11.475	12.20	12.04	11.80	11.57
2	17/64	.265	.284	.257	10.625	10.8375	11.55	11.40	10.51	10.30
3	1/4	.25	.259	.229	10.	10.2	10.53	10.39	9.36	9.18
4	15/64	.234	.238	.204	9.375	9.5625	9.68	9.55	8.34	8.17
5	7/32	.218	.22	.181	8.75	8.925	8.95	8.83	7.42	7.28
6	13/64	.203	.203	.162	8.125	8.2875	8.25	8.15	6.61	6.48
7	3/16	.187	.18	.144	7.5	7.65	7.32	7.22	5.89	5.77
8	11/64	.171	.165	.128	6.875	7.0125	6.71	6.62	5.24	5.14
9	5/32	.156	.148	.114	6.25	6.375	6.02	5.94	4.67	4.58
10	9/64	.140	.134	.101	5.625	5.7375	5.45	5.38	4.16	4.08
11	1/8	.125	.12	.09	5.	5.1	4.88	4.82	3.70	3.63
12	7/64	.109	.109	.08	4.375	4.625	4.43	4.37	3.30	3.23
13	3/32	.093	.005	.072	3.75	3.825	3.86	3.81	2.94	2.88
14	5/64	.078	.083	.064	3.125	3.1875	3.37	3.33	2.62	2.56
15	9/128	.070	.072	.057	2.8125	2.86875	2.93	2.89	2.33	2.28
16	1/16	.062	.065	.05	2.5	2.55	2.64	2.61	2.07	2.03
17	9/160	.056	.058	.045	2.25	2.295	2.36	2.33	1.85	1.81
18	1/20	.05	.049	.04	2.	2.04	1.99	1.97	1.64	1.61
19	7/160	.043	.042	.035	1.75	1.785	1.71	1.69	1.46	1.44
20	3/80	.037	.035	.032	1.50	1.53	1.42	1.40	1.31	1.28
21	11/320	.034	.032	.028	1.375	1.4025	1.30	1.28	1.16	1.14
22	1/32	.031	.028	.025	1.25	1.275	1.14	1.12	1.03	1.01
23	9/320	.028	.025	.022	1.125	1.1475	1.02	1.00	.922	.904
24	1/40	.025	.022	.020	1.	1.02	.895	.883	.82	.804
25	7/320	.021	.02	.017	.875	.8925	.813	.803	.73	.716
26	3/160	.018	.018	.015	.75	.765	.732	.732	.649	.636
27	11/640	.017	.016	.014	.6875	.70125	.651	.642	.579	.568
28	1/64	.015	.014	.012	.625	.6375	.569	.562	.514	.504
29	9/640	.014	.013	.011	.5625	.57375	.....	.....	.461	.452
30	1/80	.012	.012	.01	.5	.51	.....	.....	.408	.46
31	7/640	.010	.01	.008	.4375	.44625	.....	.....	.363	.356
32	13/1280	.010	.009	.008	.4062	.414375	.....	.....	.326	.320
33	3/320	.009	.008	.007	.375	.3825	.....	.....	.29	.284
34	11/1280	.008	.007	.006	.3437	.350625	.....	.....	.257	.252
35	5/640	.007	.005	.005	.3125	.31885	.....	.....	.228	.224
36	9/1280	.007	.004	....	.2812	.286875	.....	.....	.....	.....
37	17/2560	.006	....	....	.2656	.2709375	.....	.....	.....	.....
38	1/160	.006	....	....	.25	.255	.....	.....	.....	.....

The U. S. Standard Gauge is the one commonly used in the United States.

Commercial Practice permits of a tonnage weight variations of 2½% either way on gauges 17 to 30, inclusive, 5% either way on gauges No. 16 to No. 8.

Gallons Capacity of Rectangular Tanks

Width of Tank	Length of Tank																					
	ft. 2	ft. in. 2 6	ft. 3	ft. in. 3 6	ft. 4	ft. in. 4 6	ft. 5	ft. in. 5 6	ft. 6	ft. in. 6 6	ft. 7	ft. in. 7 6	ft 8	ft. in. 8 6	ft. 9	ft in. 9 6	ft. 10	ft in. 10 6	ft. 11	ft. in. 11 6	ft. 12
2 ft.	29.92	37.40	44.88	52.36	59.84	67.32	74.81	82.29	89.77	97.25	104.73	112.21	119.69	127.17	134.65	142.13	149.61	157.09	164 57	172.05	179.53
2 6 in.	.....	46.75	56.10	65.45	74.80	84.16	93.51	102.86	112.21	121.56	130.91	140.26	149.61	158.96	168.31	177.66	187.01	196.36	205.71	215.06	224.41
3	.....	.....	67.32	78.54	89.77	100.99	112.21	123.43	134.65	145.87	157.09	168.31	179.53	190.75	202.97	213.19	224.41	235.63	246.86	258.07	269 30
3 6 in.	.....	.....	.....	91.64	104.73	117.82	130.91	144.00	157.09	170.18	183.27	196.36	209.45	222.54	235.63	248.73	261.82	274.90	288.00	301.09	314.18
4	.....	.....	.....	.....	119.69	134.65	149.61	164.57	179.53	194.49	209.45	224.41	239.37	254.34	269.30	284.26	299.22	314.18	329.14	344.10	359.06
4 6 in.	.....	.....	.....	.....	.....	151.48	168.31	185.14	201.97	218.80	235.63	252.47	269.30	286.13	302.96	319.79	336.62	353.45	370.28	387.11	403.94
5	.....	.....	.....	.....	.....	.....	187.01	205 71	224 41	243.11	261.82	280.52	299.22	317.92	336 62	355.32	374.03	392.72	411.43	430.13	448.83
5 6 in.	.....	.....	.....	.....	.....	.....	.....	226.28	246.86	267.43	288.00	308.57	329.14	349.71	370.28	390.85	411.43	432.00	452.57	473.14	493.71
6	.....	.....	.....	.....	.....	.....	.....	.....	269.30	291.74	314.18	336.62	359.06	381.50	403.94	426.39	448.83	471.27	493.71	516.15	538.59
6 6 in.	.....	.....	.....	.....	.....	.....	.....	.....	.....	316.05	340.36	364.67	388.98	413.30	437.60	461.92	486.23	510.54	534.85	559.16	583.47
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	366 54	392.72	418 91	445.09	471 27	497.45	523.64	549.81	575.99	602.18	628.36
7 6 in.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	420.78	448.83	476.88	504.93	532.98	561.04	589.08	617.14	645.19	673.24
8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	478.75	508.67	538.59	568.51	598.44	628.36	658.28	688.20	718.12
8 6 in.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	540.46	572.25	604.05	635.84	667.63	699.42	731.21	763.00
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	605.92	639.58	673.25	706.90	740.56	774.23	807.89
9 6 in.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	675.11	710.65	746.17	781.71	817.24	852.77
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	748.05	785.45	822.86	860.26	897.66
10 6 in.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	824.73	864.00	903.26	942 56
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	905.14	946.27	987.43
11 6 in.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	989.29	1032.3
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1077 2

Areas and Circumferences of Circles

Diam.	Area	Circum.	Diam.	Area	Circum.	Diam.	Area	Circum.
1/64	.00019	.04909	2 3/8	4.4301	7.4613	7 7/8	48.707	24.740
1/32	.00077	.09818	7/16	4.6664	7.6576	8.	50.265	25.133
3/64	.00173	.14726	1/2	4.9087	7.8540	1/8	51.849	25.525
1/16	.00307	.19635	9/16	5.1572	8.0503	1/4	53.456	25.918
5/64	.00479	.24544	5/8	5.4119	8.2467	3/8	55.088	26.311
3/32	.00690	.29452	11/16	5.6727	8.4430	1/2	56.745	26.704
7/64	.00939	.34361	3/4	5.9396	8.6394	5/8	58.426	27.096
1/8	.01227	.39270	13/16	6.2126	8.8357	3/4	60.132	27.489
9/32	.01917	.49087	7/8	6.4918	9.0321	7/8	61.862	27.882
5/16	.02761	.58905	15/16	6.7771	9.2284	9.	63.617	28.274
11/32	.03758	.68722	3.	7.0686	9.4248	1/8	65.397	28.667
3/8	.04909	.78540	1/16	7.3662	9.6211	1/4	67.201	29.060
13/32	.06213	.88357	1/8	7.6699	9.8175	3/8	69.029	29.452
7/16	.07670	.98175	3/16	7.9798	10.014	1/2	70.882	29.845
15/32	.09281	1.0799	1/4	8.2958	10.210	5/8	72.760	30.238
1/2	.11045	1.1781	5/16	8.6179	10.407	3/4	74.662	30.631
17/32	.12962	1.2763	3/8	8.9462	10.603	7/8	76.589	31.023
9/16	.15033	1.3744	7/16	9.2806	10.799	10.	78.540	31.416
19/32	.17257	1.4726	1/2	9.6211	10.996	1/8	80.516	31.809
5/8	.19635	1.5708	9/16	9.9678	11.192	1/4	82.516	32.201
21/32	.22166	1.6690	5/8	10.321	11.388	3/8	84.541	32.594
11/16	.24850	1.7671	11/16	10.680	11.585	1/2	86.590	32.987
23/32	.27688	1.8653	3/4	11.045	11.781	5/8	88.664	33.379
3/4	.30680	1.9635	13/16	11.416	11.977	3/4	90.763	33.772
25/32	.33824	2.0617	7/8	11.793	12.174	7/8	92.886	34.165
13/16	.37122	2.1598	15/16	12.177	12.370	11.	95.033	34.558
27/32	.40574	2.2580	4.	12.566	12.566	1/8	97.205	34.950
7/8	.44179	2.3562	1/16	12.962	12.763	1/4	99.402	35.343
29/32	.47937	2.4544	1/8	13.364	12.959	3/8	101.62	35.736
15/16	.51849	2.5525	3/16	13.772	13.155	1/2	103.87	36.128
31/32	.55914	2.6507	1/4	14.186	13.352	5/8	106.14	36.521
1/8	.60132	2.7489	5/16	14.607	13.548	3/4	108.43	36.914
33/32	.64504	2.8471	3/8	15.033	13.744	7/8	110.75	37.306
17/16	.69029	2.9452	7/16	15.466	13.941	12.	113.10	37.699
35/32	.73708	3.0434	1/2	15.904	14.137	1/8	115.47	38.092
1.	.7854	3.1416	9/16	16.349	14.334	1/4	117.86	38.485
1/32	.8352	3.2397	5/8	16.800	14.530	3/8	120.28	38.877
1/16	.8866	3.3379	11/16	17.257	14.726	1/2	122.72	39.270
3/32	.9396	3.4361	3/4	17.721	14.923	5/8	125.19	39.663
1/8	.9940	3.5343	13/16	18.190	15.119	3/4	127.68	40.055
5/32	1.0500	3.6324	7/8	18.665	15.315	7/8	130.19	40.448
3/16	1.1075	3.7306	15/16	19.147	15.512	13.	132.73	40.841
7/32	1.1666	3.8288	5.	19.635	15.708	1/8	135.30	41.233
1/4	1.2272	3.9270	1/16	20.129	15.904	1/4	137.89	41.626
9/32	1.2893	4.0251	1/8	20.629	16.101	3/8	140.50	42.019
5/16	1.3530	4.1233	3/16	21.135	16.297	1/2	143.14	42.412
11/32	1.4182	4.2215	1/4	21.648	16.493	5/8	145.80	42.804
3/8	1.4849	4.3197	5/16	22.166	16.690	3/4	148.49	43.197
13/32	1.5531	4.4178	3/8	22.691	16.886	7/8	151.20	43.590
7/16	1.6230	4.5160	7/16	23.221	17.082	14.	153.94	43.982
15/32	1.6943	4.6142	1/2	23.758	17.279	1/8	156.70	44.375
1/2	1.7671	4.7124	9/16	24.301	17.475	1/4	159.48	44.768
17/32	1.8415	4.8105	5/8	24.850	17.671	3/8	162.30	45.160
9/16	1.9175	4.9087	11/16	25.406	17.868	1/2	165.13	45.553
19/32	1.9949	5.0070	3/4	25.967	18.064	5/8	167.99	45.946
5/8	2.0739	5.1051	13/16	26.535	18.261	3/4	170.87	46.338
21/32	2.1545	5.2033	7/8	27.109	18.457	7/8	173.78	46.731
11/16	2.2365	5.3014	15/16	27.688	18.653	15.	176.71	47.124
23/32	2.3201	5.3996	6.	28.274	18.850	1/8	179.67	47.517
3/4	2.4053	5.4978	1/8	29.465	19.242	1/4	182.65	47.909
25/32	2.4919	5.5960	1/4	30.680	19.635	3/8	185.66	48.302
13/16	2.5802	5.6941	3/8	31.919	20.028	1/2	188.69	48.695
27/32	2.6700	5.7923	1/2	33.183	20.420	5/8	191.75	49.087
7/8	2.7612	5.8905	5/8	34.472	20.813	3/4	194.83	49.480
29/32	2.8540	5.9887	3/4	35.785	21.206	7/8	197.93	49.873
15/16	2.9483	6.0868	7/8	37.122	21.598	16.	201.06	50.265
31/32	3.0442	6.1850	7.	38.485	21.991	1/8	204.22	50.658
2.	3.1416	6.2832	1/8	39.871	22.384	1/4	207.39	51.051
1/16	3.3410	6.4795	1/4	41.282	22.776	3/8	210.60	51.444
1/8	3.5466	6.6759	3/8	42.718	23.169	1/2	213.82	51.836
3/16	3.7583	6.8722	1/2	44.179	23.562	5/8	217.08	52.229
1/4	3.9761	7.0686	5/8	45.664	23.955	3/4	220.35	52.622
5/16	4.2000	7.2649	3/4	47.173	24.347	7/8	223.65	53.014

Areas and Circumferences of Circles

Diam.	Area	Circum.	Diam.	Area	Circum.	Diam.	Area	Circum.
17.	226.98	53.407	26.	530.93	81.681	35.	962.11	109.956
1/8	230.33	53.800	1/8	536.05	82.074	1/8	969.00	110.348
1/4	233.71	54.192	1/4	541.19	82.467	1/4	975.91	110.741
3/8	237.10	54.585	3/8	546.35	82.860	3/8	982.84	111.134
1/2	240.53	54.978	1/2	551.55	83.252	1/2	989.80	111.527
5/8	243.98	55.371	5/8	556.76	83.645	5/8	996.78	111.919
3/4	247.45	55.763	3/4	562.00	84.038	3/4	1003.8	112.312
7/8	250.95	56.156	7/8	567.27	84.430	7/8	1010.8	112.705
18.	254.47	56.549	27.	572.56	84.823	36.	1017.9	113.097
1/8	258.02	56.941	1/8	577.87	85.216	1/8	1025.0	113.490
1/4	261.59	57.334	1/4	583.21	85.608	1/4	1032.1	113.883
3/8	265.18	57.727	3/8	588.57	86.001	3/8	1039.2	114.275
1/2	268.80	58.119	1/2	593.96	86.394	1/2	1046.3	114.668
5/8	272.45	58.512	5/8	599.37	86.786	5/8	1053.5	115.061
3/4	276.12	58.905	3/4	604.81	87.179	3/4	1060.7	115.454
7/8	279.81	59.298	7/8	610.27	87.572	7/8	1068.0	115.846
19.	283.53	59.690	28.	615.75	87.965	37.	1075.2	116.239
1/8	287.27	60.083	1/8	621.26	88.357	1/8	1082.5	116.632
1/4	291.04	60.476	1/4	626.80	88.750	1/4	1089.8	117.024
3/8	294.83	60.868	3/8	632.36	89.143	3/8	1097.1	117.417
1/2	298.65	61.261	1/2	637.94	89.535	1/2	1104.5	117.810
5/8	302.49	61.654	5/8	643.55	89.928	5/8	1111.8	118.202
3/4	306.35	62.046	3/4	649.18	90.321	3/4	1119.2	118.596
7/8	310.24	62.439	7/8	654.84	90.713	7/8	1126.7	118.988
20.	314.16	62.832	29.	660.52	91.106	38.	1134.1	119.381
1/8	318.10	63.225	1/8	666.23	91.499	1/8	1141.6	119.773
1/4	322.06	63.617	1/4	671.96	91.892	1/4	1149.1	120.166
3/8	326.05	64.010	3/8	677.71	92.284	3/8	1156.6	120.559
1/2	330.06	64.403	1/2	683.49	92.677	1/2	1164.2	120.951
5/8	334.10	64.795	5/8	689.30	93.070	5/8	1171.7	121.344
3/4	338.16	65.188	3/4	695.13	93.462	3/4	1179.3	121.737
7/8	342.25	65.581	7/8	700.98	93.855	7/8	1186.9	122.129
21.	346.36	65.973	30.	706.86	94.248	39.	1194.6	122.522
1/8	350.50	66.366	1/8	712.76	94.640	1/8	1202.3	122.915
1/4	354.66	66.759	1/4	718.69	95.033	1/4	1210.0	123.308
3/8	358.84	67.152	3/8	724.64	95.426	3/8	1217.7	123.700
1/2	363.05	67.544	1/2	730.62	95.819	1/2	1225.4	124.093
5/8	367.28	67.937	5/8	736.62	96.211	5/8	1233.2	124.486
3/4	371.54	68.330	3/4	742.64	96.604	3/4	1241.0	124.878
7/8	375.83	68.722	7/8	748.69	96.997	7/8	1248.8	125.271
22.	380.13	69.115	31.	754.77	97.389	40.	1256.6	125.664
1/8	384.46	69.508	1/8	760.87	97.782	1/8	1264.5	126.056
1/4	388.82	69.900	1/4	766.99	98.175	1/4	1272.4	126.449
3/8	393.20	70.293	3/8	773.14	98.567	3/8	1280.3	126.842
1/2	397.61	70.686	1/2	779.31	98.960	1/2	1288.2	127.235
5/8	402.04	71.079	5/8	785.51	99.353	5/8	1296.2	127.627
3/4	406.49	71.471	3/4	791.73	99.746	3/4	1304.2	128.020
7/8	410.97	71.864	7/8	797.98	100.138	7/8	1312.2	128.413
23.	415.48	72.257	32.	804.25	100.531	41.	1320.3	128.805
1/8	420.00	72.649	1/8	810.54	100.924	1/8	1328.3	129.198
1/4	424.56	73.042	1/4	816.86	101.316	1/4	1336.4	129.591
3/8	429.13	73.435	3/8	823.21	101.709	3/8	1344.5	129.983
1/2	433.74	73.827	1/2	829.58	102.102	1/2	1352.7	130.376
5/8	438.36	74.220	5/8	835.97	102.494	5/8	1360.8	130.769
3/4	443.01	74.613	3/4	842.39	102.887	3/4	1369.0	131.161
7/8	447.69	75.006	7/8	848.83	103.280	7/8	1377.2	131.554
24.	452.39	75.398	33.	855.30	103.673	42.	1385.4	131.947
1/8	457.11	75.791	1/8	861.79	104.065	1/8	1393.7	132.340
1/4	461.86	76.184	1/4	868.31	104.458	1/4	1402.0	132.732
3/8	466.64	76.576	3/8	874.85	104.851	3/8	1410.3	133.125
1/2	471.44	76.969	1/2	881.41	105.243	1/2	1418.6	133.518
5/8	476.26	77.362	5/8	888.00	105.636	5/8	1427.0	133.910
3/4	481.11	77.754	3/4	894.62	106.029	3/4	1435.4	134.303
7/8	485.98	78.147	7/8	901.26	106.421	7/8	1443.8	134.696
25.	490.87	78.540	34.	907.92	106.814	43.	1452.2	135.088
1/8	495.79	78.933	1/8	914.61	107.207	1/8	1460.7	135.481
1/4	500.74	79.325	1/4	921.32	107.600	1/4	1469.1	135.874
3/8	505.71	79.718	3/8	928.06	107.992	3/8	1477.6	136.267
1/2	510.71	80.111	1/2	934.82	108.385	1/2	1486.2	136.659
5/8	515.72	80.503	5/8	941.61	108.778	5/8	1494.7	137.052
3/4	520.77	80.896	3/4	948.42	109.170	3/4	1503.3	137.445
7/8	525.84	81.289	7/8	955.25	109.563	7/8	1511.9	137.837

Areas and Circumferences of Circles

Diam.	Area	Circum.	Diam.	Area	Circum.	Diam.	Area	Circum.
44.	1520.5	138.230	53 3/8	2237.5	167.683	62 3/4	3092.6	197.135
1/8	1529.2	138.623	1/2	2248.0	168.075	7/8	3104.9	197.528
1/4	1537.9	139.015	5/8	2258.5	168.468	63.	3117.2	197.920
3/8	1546.6	139.408	3/4	2269.1	168.861	1/8	3129.6	198.313
1/2	1555.3	139.801	7/8	2279.6	169.253	1/4	3142.0	198.706
5/8	1564.0	140.194	54.	2290.2	169.646	3/8	3154.5	199.098
3/4	1572.8	140.586	1/8	2300.8	170.039	1/2	3166.9	199.491
7/8	1581.6	140.979	1/4	2311.5	170.431	5/8	3179.4	199.884
45.	1590.4	141.372	3/8	2322.1	170.824	3/4	3191.9	200.277
1/8	1599.3	141.764	1/2	2332.8	171.217	7/8	3204.4	200.669
1/4	1608.2	142.157	5/8	2343.5	171.609	64.	3217.0	201.062
3/8	1617.0	142.550	3/4	2354.3	172.002	1/8	3229.6	201.455
1/2	1626.0	142.942	7/8	2365.0	172.395	1/4	3242.2	201.847
5/8	1634.9	143.335	55.	2375.8	172.788	3/8	3254.8	202.240
3/4	1643.9	143.728	1/8	2386.6	173.180	1/2	3267.5	202.633
7/8	1652.9	144.121	1/4	2397.5	173.573	5/8	3280.1	203.025
46.	1661.9	144.513	3/8	2408.3	173.966	3/4	3292.8	203.418
1/8	1670.9	144.906	1/2	2419.2	174.358	7/8	3305.6	203.811
1/4	1680.0	145.299	5/8	2430.1	174.751	65.	3318.3	204.204
3/8	1689.1	145.691	3/4	2441.1	175.144	1/8	3331.1	204.596
1/2	1698.2	146.084	7/8	2452.0	175.536	1/4	3343.9	204.989
5/8	1707.4	146.477	56.	2463.0	175.929	3/8	3356.7	205.382
3/4	1716.5	146.869	1/8	2474.0	176.322	1/2	3369.6	205.774
7/8	1725.7	147.262	1/4	2485.0	176.715	5/8	3382.4	206.167
47.	1734.9	147.655	3/8	2496.1	177.107	3/4	3395.3	206.560
1/8	1744.2	148.048	1/2	2507.2	177.500	7/8	3408.2	206.952
1/4	1753.5	148.440	5/8	2518.3	177.893	66.	3421.2	207.345
3/8	1762.7	148.833	3/4	2529.4	178.285	1/8	3434.2	207.738
1/2	1772.1	149.226	7/8	2540.6	178.678	1/4	3447.2	208.131
5/8	1781.4	149.618	57.	2551.8	179.071	3/8	3460.2	208.523
3/4	1790.8	150.011	1/8	2563.0	179.463	1/2	3473.2	208.916
7/8	1800.1	150.404	1/4	2574.2	179.856	5/8	3486.3	209.309
48.	1809.6	150.796	3/8	2585.4	180.249	3/4	3499.4	209.701
1/8	1819.0	151.189	1/2	2596.7	180.642	7/8	3512.5	210.094
1/4	1828.5	151.582	5/8	2608.0	181.034	67.	3525.7	210.487
3/8	1837.9	151.975	3/4	2619.4	181.427	1/8	3538.8	210.879
1/2	1847.5	152.367	7/8	2630.7	181.820	1/4	3552.0	211.272
5/8	1857.0	152.760	58.	2642.1	182.212	3/8	3565.2	211.665
3/4	1866.5	153.153	1/8	2653.5	182.605	1/2	3578.5	212.058
7/8	1876.1	153.545	1/4	2664.9	182.998	5/8	3591.7	212.450
49.	1885.7	153.938	3/8	2676.4	183.390	3/4	3605.0	212.843
1/8	1895.4	154.331	1/2	2687.8	183.783	7/8	3618.3	213.236
1/4	1905.0	154.723	5/8	2699.3	184.176	68.	3631.7	213.628
3/8	1914.7	155.116	3/4	2710.9	184.569	1/8	3645.0	214.021
1/2	1924.4	155.509	7/8	2722.4	184.961	1/4	3658.4	214.414
5/8	1934.2	155.902	59.	2734.0	185.354	3/8	3671.8	214.806
3/4	1943.9	156.294	1/8	2745.6	185.747	1/2	3685.3	215.199
7/8	1953.7	156.687	1/4	2757.2	186.139	5/8	3698.7	215.592
50.	1963.5	157.080	3/8	2768.8	186.532	3/4	3712.2	215.984
1/8	1973.3	157.472	1/2	2780.5	186.925	7/8	3725.7	216.377
1/4	1983.2	157.865	5/8	2792.2	187.317	69.	3739.3	216.770
3/8	1993.1	158.258	3/4	2803.9	187.710	1/8	3752.8	217.163
1/2	2003.0	158.650	7/8	2815.7	188.103	1/4	3766.4	217.555
5/8	2012.9	159.043	60.	2827.4	188.496	3/8	3780.0	217.948
3/4	2022.8	159.436	1/8	2839.2	188.888	1/2	3793.7	218.341
7/8	2032.8	159.829	1/4	2851.0	189.281	5/8	3807.3	218.733
51.	2042.8	160.221	3/8	2862.9	189.674	3/4	3821.0	219.126
1/8	2052.8	160.614	1/2	2874.8	190.066	7/8	3834.7	219.519
1/4	2062.9	161.007	5/8	2886.6	190.459	70.	3848.5	219.911
3/8	2073.0	161.399	3/4	2898.6	190.852	1/8	3862.2	220.304
1/2	2083.1	161.792	7/8	2910.5	191.244	1/4	3876.0	220.697
5/8	2093.2	162.185	61.	2922.5	191.637	3/8	3889.8	221.090
3/4	2103.3	162.577	1/8	2934.5	192.030	1/2	3903.6	221.482
7/8	2113.5	162.970	1/4	2946.5	192.423	5/8	3917.5	221.875
52.	2123.7	163.363	3/8	2958.5	192.815	3/4	3931.4	222.268
1/8	2133.9	163.756	1/2	2970.6	193.208	7/8	3945.3	222.660
1/4	2144.2	164.148	5/8	2982.7	193.601	71.	3959.2	223.053
3/8	2154.5	164.541	3/4	2994.8	193.993	1/8	3973.1	223.446
1/2	2164.8	164.934	7/8	3006.9	194.386	1/4	3987.1	223.838
5/8	2175.1	165.326	62.	3019.1	194.779	3/8	4001.1	224.231
3/4	2185.4	165.719	1/8	3031.3	195.171	1/2	4015.2	224.624
7/8	2195.8	166.112	1/4	3043.5	195.564	5/8	4029.2	225.017
53.	2206.2	166.504	3/8	3055.7	195.957	3/4	4043.3	225.409
1/8	2216.6	166.897	1/2	3068.0	196.350	7/8	4057.4	225.802
1/4	2227.0	167.290	5/8	3080.3	196.742	72.	4071.5	226.195

Areas and Circumferences of Circles

Diam.	Area	Circum.	Diam.	Area.	Circum.	Diam.	Area	Circum.
72 1/8	4085.7	226.587	81 1/2	5216.8	256.040	90 7/8	6486.0	285.492
1/4	4099.8	226.980	5/8	5232.8	256.433	91.	6503.9	285.885
3/8	4114.0	227.373	3/4	5248.9	256.825	1/8	6521.8	286.278
1/2	4128.2	227.765	7/8	5264.9	257.218	1/4	6539.7	286.670
5/8	4142.5	228.158	82.	5281.0	257.611	3/8	6557.6	287.063
3/4	4156.8	228.551	1/8	5297.1	258.003	1/2	6575.5	287.456
7/8	4171.1	228.944	1/4	5313.3	258.396	5/8	6593.5	287.848
73.	4185.4	229.336	3/8	5329.4	258.789	3/4	6611.5	288.241
1/8	4199.7	229.729	1/2	5345.6	259.181	7/8	6629.6	288.634
1/4	4214.1	230.122	5/8	5361.8	259.574	92.	6647.6	289.027
3/8	4228.5	230.514	3/4	5378.1	259.967	1/8	6665.7	289.419
1/2	4242.9	230.907	7/8	5394.3	260.359	1/4	6683.8	289.812
5/8	4257.4	231.300	83.	5410.6	260.752	3/8	6701.9	290.205
3/4	4271.8	231.692	1/8	5426.9	261.145	1/2	6720.1	290.597
7/8	4286.3	232.085	1/4	5443.3	261.538	5/8	6738.2	290.990
74.	4300.8	232.478	3/8	5459.6	261.930	3/4	6756.4	291.383
1/8	4315.4	232.871	1/2	5476.0	262.323	7/8	6774.7	291.775
1/4	4329.9	233.263	5/8	5492.4	262.716	93.	6792.9	292.168
3/8	4344.5	233.656	3/4	5508.8	263.108	1/8	6811.2	292.561
1/2	4359.2	234.049	7/8	5525.3	263.501	1/4	6829.5	292.954
5/8	4373.8	234.441	84.	5541.8	263.894	3/8	6847.8	293.346
3/4	4388.5	234.834	1/8	5558.3	264.286	1/2	6866.1	293.739
7/8	4403.1	235.227	1/4	5574.8	264.679	5/8	6884.5	294.132
75.	4417.9	235.619	3/8	5591.4	265.072	3/4	6902.9	294.524
1/8	4432.6	236.012	1/2	5607.9	265.465	7/8	6921.3	294.917
1/4	4447.4	236.405	5/8	5624.5	265.857	94.	6939.8	295.310
3/8	4462.2	236.798	3/4	5641.2	266.250	1/8	6958.2	295.702
1/2	4477.0	237.190	7/8	5657.8	266.643	1/4	6976.7	296.095
5/8	4491.8	237.583	85.	5674.5	267.035	3/8	6995.3	296.488
3/4	4506.7	237.976	1/8	5691.2	267.428	1/2	7013.8	296.881
7/8	4521.5	238.368	1/4	5707.9	267.821	5/8	7032.4	297.273
76.	4536.5	238.761	3/8	5724.7	268.213	3/4	7051.0	297.666
1/8	4551.4	239.154	1/2	5741.5	268.606	7/8	7069.6	298.059
1/4	4566.4	239.546	5/8	5758.3	268.999	95.	7088.2	298.451
3/8	4581.3	239.939	3/4	5775.1	269.392	1/8	7106.9	298.844
1/2	4596.3	240.332	7/8	5791.9	269.784	1/4	6125.6	299.237
5/8	4611.4	240.725	86.	5808.8	270.177	3/8	7144.3	299.629
3/4	4626.4	241.117	1/8	5825.7	270.570	1/2	7163.0	300.022
7/8	4641.5	241.510	1/4	5842.6	270.962	5/8	7181.8	300.415
77.	4656.6	241.903	3/8	5859.6	271.355	3/4	7200.6	300.807
1/8	4671.8	242.295	1/2	5876.5	271.748	7/8	7219.4	301.200
1/4	4686.9	242.688	5/8	5893.5	272.140	96.	7238.2	301.593
3/8	4702.1	243.081	3/4	5910.6	272.533	1/8	7257.1	301.986
1/2	4717.3	243.473	7/8	5927.6	272.926	1/4	7276.0	302.378
5/8	4732.5	243.866	87.	5944.7	273.319	3/8	7294.9	302.771
3/4	4747.8	244.259	1/8	5961.8	273.711	1/2	7313.8	303.164
7/8	4763.1	244.652	1/4	5978.9	274.104	5/8	7332.8	303.556
78.	4778.4	245.044	3/8	5996.0	274.497	3/4	7351.8	303.949
1/8	4793.7	245.437	1/2	6013.2	274.889	7/8	7370.8	304.342
1/4	4809.0	245.830	5/8	6030.4	275.282	97.	7389.8	304.734
3/8	4824.4	246.222	3/4	6047.6	275.675	1/8	7408.9	305.127
1/2	4839.8	246.615	7/8	6064.9	276.067	1/4	7428.0	305.520
5/8	4855.2	247.008	88.	6082.1	276.460	3/8	7447.1	305.913
3/4	4870.7	247.400	1/8	6099.4	276.853	1/2	7466.2	306.305
7/8	4886.2	247.793	1/4	6116.7	277.246	5/8	7485.3	306.698
79.	4901.7	248.186	3/8	6134.1	277.638	3/4	7504.5	307.091
1/8	4917.2	248.579	1/2	6151.4	278.031	7/8	7523.7	307.483
1/4	4932.7	248.971	5/8	6168.8	278.424	98.	7543.0	307.876
3/8	4948.3	249.364	3/4	6186.2	278.816	1/8	7562.2	308.269
1/2	4963.9	249.757	7/8	6203.7	279.209	1/4	7581.5	308.661
5/8	4979.5	250.149	89.	6221.1	279.602	3/8	7600.8	309.054
3/4	4995.2	250.542	1/8	6238.6	279.994	1/2	7620.1	309.447
7/8	5010.9	250.935	1/4	6256.1	280.387	5/8	7639.5	309.840
80.	5026.5	251.327	3/8	6273.7	280.780	3/4	7658.9	310.232
1/8	5042.3	251.720	1/2	6291.2	281.173	7/8	7678.3	310.625
1/4	5058.0	252.113	5/8	6308.8	281.565	99.	7697.7	311.018
3/8	5073.8	252.506	3/4	6326.4	281.958	1/8	7717.1	311.410
1/2	5089.6	252.898	7/8	6344.1	282.351	1/4	7736.6	311.803
5/8	5105.4	253.291	90.	6361.7	282.743	3/8	7756.1	312.196
3/4	5121.2	253.684	1/8	6379.4	283.136	1/2	7775.6	312.588
7/8	5137.1	254.076	1/4	6397.1	283.529	5/8	7795.2	312.981
81.	5153.0	254.469	3/8	6414.9	283.921	3/4	7814.8	313.374
1/8	5168.9	254.862	1/2	6432.6	284.314	7/8	7834.4	313.767
1/4	5184.9	255.254	5/8	6450.4	284.707	100.	7854.0	314.159
3/8	5200.8	255.647	3/4	6468.2	285.100			

Capacity of Cylindrical Vessels per Ft. of Length

Diameter		Area* Sq. Ft.	Vol. Cu. In.	Gal. (U. S.)
Ft.	In.			
0	1/4	.0003	.5775	.0025
	5/16	.0005	.9240	.004
	3/8	.0008	1.3167	.0057
	7/16	.001	1.8018	.0078
	1/2	.0014	2.3562	.0102
	9/16	.0017	2.9799	.0129
	5/8	.0021	3.6729	.0159
	11/16	.0026	4.4583	.0193
	3/4	.0031	5.3130	.0230
	13/16	.0036	6.2139	.0269
	7/8	.0042	7.2072	.0312
	15/16	.0048	8.2929	.0359
	1	.0055	9.4248	.0408
	1 1/4	.0085	14.738	.0638
	1 1/2	.0123	21.206	.0918
	1 3/4	.0167	28.852	.1249
	2	.0218	37.699	.1632
	2 1/4	.0276	47.725	.2066
	2 1/2	.0341	58.905	.2550
	2 3/4	.0412	71.263	.3085
	3	.0491	84.823	.3672
	3 1/4	.0576	99.538	.4309
	3 1/2	.0668	115.45	.4998
	3 3/4	.0767	132.56	.5738
	4	.0873	150.80	.6528
	4 1/4	.0985	170.22	.7369
	4 1/2	.1104	190.87	.8263
	4 3/4	.1231	212.66	.9206
	5	.1364	235.62	1.020
	5 1/4	.1503	259.87	1.125
	5 1/2	.1650	285.05	1.234
	5 3/4	.1803	311.62	1.349
	6	.1963	339.34	1.469
	6 1/4	.2131	368.21	1.594
	6 1/2	.2304	398.24	1.724
	6 3/4	.2485	429.43	1.859
	7	.2673	461.77	1.999
	7 1/4	.2867	495.49	2.145
	7 1/2	.3068	530.14	2.295
	7 3/4	.3276	563.95	2.45
	8	.3491	603.14	2.611
	8 1/4	.3712	641.49	2.777
	8 1/2	.3941	680.99	2.948
	8 3/4	.4176	721.87	3.125
	9	.4418	763.45	3.305
	9 1/4	.4667	816.42	3.491
	9 1/2	.4932	850.54	3.682
	9 3/4	.5185	896.05	3.879
	10	.5454	942.48	4.08
	10 1/4	.5730	990.07	4.286
	10 1/2	.6013	1039.0	4.498
	10 3/4	.6303	1089.2	4.715
	11	.66	1140.4	4.937
	11 1/4	.6903	1192.9	5.164
	11 1/2	.7213	1246.5	5.396
	11 3/4	.7530	1301.2	5.633
1	0	.7854	1357.1	5.875
	1/2	.8522	1472.6	6.375
	1	.9218	1592.7	6.895
1	1 1/2	.994	1717.7	7.436
	2	1.069	1847.3	7.999
	2 1/2	1.147	1981.5	8.578
	3	1.227	2120.6	9.180
	3 1/2	1.310	2264.0	9.800
	4	1.396	2411.6	10.44
	4 1/2	1.485	2566.4	11.11
	5	1.576	2723.4	11.79
	5 1/2	1.670	2885.3	12.49
	6	1.768	3053.8	13.22
	6 1/2	1.867	3224.8	13.96
	7	1.969	3402.6	14.73
	7 1/2	2.074	3582.8	15.51
	8	2.182	3796.9	16.32
	8 1/2	2.292	3961.6	17.15
	9	2.405	4155.6	17.99
	9 1/2	2.521	4356.7	18.86
	10	2.640	4562.2	19.75
	10 1/2	2.761	4772.5	20.66
	11	2.885	4984.9	21.58
	11 1/2	3.012	5204.4	22.53
2	0	3.142	5428.5	23.50
	1	3.409	5890.5	25.50
	2	3.687	6370.9	25.58
	3	3.976	6869.9	29.74
	4	4.276	7388.7	31.99
	5	4.587	7925.6	34.31
	6	4.909	8482.3	36.72
	7	5.241	9057.5	39.21
	8	5.585	9651.2	41.78
	9	5.940	10263.	44.43
	10	6.305	10893.	47.16
	11	6.681	11545.	49.98
3	0	7.069	12115.	52.88
	1	7.467	12903.	55.86
	2	7.876	13610.	58.92
	3	8.296	14335.	62.06
	4	8.727	15079.	65.28
	5	9.168	15842.	68.58
	6	9.621	16625.	71.97
	7	10.085	17426.	75.44
	8	10.559	18246.	78.99
	9	11.045	19085.	82.62
	10	11.541	19942.	86.33
	11	12.048	20813.	90.10
4	0	12.566	21714.	94.00
	1	13.095	22628.	97.96
	2	13.635	23562.	102.00
	3	14.186	24509.	106.12
	4	14.748	25479.	110.32
	5	15.321	26472.	114.61
	6	15.90	27466.	118.97
	7	16.50	28505.	123.42
	8	17.10	29545.	127.95
	9	17.72	30607.	132.56
	10	18.35	31693.	137.25
	11	18.99	32802.	142.02
5	0	19.63	33910.	146.88
	1	20.29	35065.	151.82

*Also equals cu. ft. volume per ft. length.

Capacity of Cylindrical Vessels per Ft. of Length

Diameter		Area* Sq. Ft.	Vol. Cu. In.	Gal. (U. S.)	Diameter		Area* Sq. Ft.	Vol. Cu. In.	Gal. (U. S.)
Ft.	In.				Ft.	In.			
5	2	20.97	36228	156.83	18	3	261.59	452021	1956.8
	3	21.65	37406	161.93		6	268.80	464495	2010.8
	4	22.34	38605	167.12		9	276.12	477131	2065.5
	5	23.04	39820	172.38					
	6	23.76	41053	177.72	19	0	283.53	489928	2120.9
	7	24.48	42308	183.15		3	291.04	502910	2177.1
	8	25.22	43585	188.68		6	298.65	516054	2234.0
	9	25.97	44872	194.25		9	306.35	529383	2291.7
	10	26.73	46182	199.92					
	11	27.49	47510	205.67	20	0	314.16	542873	2350.1
						3	322.06	556525	2409.2
6	0	28.27	48859	211.51		6	330.06	570362	2469.1
	3	30.68	53015	229.50		9	338.16	584338	2529.6
	6	33.18	57341	248.23					
	9	35.78	61836	267.69	21	0	346.36	598521	2591.0
						3	354.66	612843	2653.0
7	0	38.48	66500	287.88		6	363.05	627350	2715.8
	3	41.28	71335	308.81		9	371.54	642018	2779.3
	6	44.18	76341	330.48					
	9	47.17	81515	352.88	22	0	380.13	656872	2843.6
						3	388.82	671887	2908.6
8	0	50.27	86858	376.01		6	397.61	687063	2974.3
	3	53.46	92372	399.88		9	406.49	702425	3040.8
	6	56.75	98055	424.48					
	9	60.13	103908	449.82	23	0	415.48	717948	3108.0
						3	424.56	733633	3175.9
9	0	63.62	109931	475.89		6	433.74	749503	3244.6
	3	67.20	116123	502.70		9	443.01	765534	3314.0
	6	70.88	122485	530.24					
	9	74.66	129016	558.51	24	0	452.39	781727	3384.1
						3	461.86	798105	3455.0
10	0	78.54	135717	587.52		6	471.44	814645	3526.6
	3	82.52	142587	617.26		9	481.11	831346	3598.9
	6	86.59	149628	647.74					
	9	90.76	156837	678.95	25	0	490.87	848232	3672.0
						3	500.74	865280	3745.8
11	0	95.03	164218	710.90		6	510.71	882489	3820.3
	3	99.40	171767	743.58		9	520.77	899884	3895.4
	6	103.87	179485	776.99	26	0	530.93	917440	3971.6
	9	108.43	187373	811.14		3	541.19	935180	4048.4
						6	551.55	953083	4125.9
12	0	113.10	195433	846.03		9	562.00	971147	4204.1
	3	117.86	203661	881.65					
	6	122.72	212058	918.00	27	0	572.56	989373	4283.0
	9	127.68	220625	955.09		3	583.21	1007784	4362.7
						6	593.96	1026356	4443.1
13	0	132.73	229362	992.91		9	604.81	1045113	4524.3
	3	137.89	238277	1031.5					
	6	143.14	247255	1070.8	28	0	615.75	1064032	4606.2
	9	148.49	256595	1110.8		3	626.80	1083113	4688.8
						6	637.94	1102355	4772.1
14	0	153.94	265997	1151.5		9	649.18	1121782	4856.2
	3	159.48	275583	1193.0					
	6	165.13	285354	1235.3	29	0	660.52	1141371	4941.0
	9	170.87	295264	1278.2		3	671.96	1161145	5026.6
15	0	176.71	305359	1321.9		6	683.49	1181080	5112.9
	3	182.65	318179	1366.4		9	695.13	1201177	5199.9
	6	188.69	326057	1411.5	30	0	706.80	1221459	5287.7
	9	194.83	336659	1457.4		3	718.60	1241902	5376.2
						6	730.62	1262507	5465.4
16	0	201.06	347447	1504.1		9	742.64	1283297	5555.4
	3	207.39	358373	1551.4					
	6	213.82	369489	1599.5	31	0	754.77	1304249	5646.1
	9	220.35	380780	1648.4		3	766.99	1325363	5737.5
						6	779.31	1346661	5829.7
17	0	226.98	392215	1697.9		9	791.73	1368121	5922.6
	3	233.71	403834	1748.2	32	0	804.25	1389742	6016.2
	6	240.53	415638	1799.3		3	816.86	1411549	6110.6
	9	247.45	427604	1851.1		6	829.58	1433517	6205.7
18	0	254.47	439732	1903.6		9	842.39	1455647	6301.5

*Also equals cu. ft. volume per ft. length

Weight of Circular Steel Plates

Dia. In.	Thickness, inches										
	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4
16	7	11	15	18	22	25	29	...	...	...	...
17	8	12	16	20	24	28	32	...	...	...	...
18	9	14	18	23	27	32	36	...	...	...	...
19	10	15	20	25	30	35	40	...	...	...	...
20	11	17	23	28	34	39	45	...	...	...	...
21	12	19	25	31	37	43	49	...	...	...	...
22	14	20	27	34	41	47	54	...	...	...	...
23	15	22	30	37	44	52	59	...	...	...	...
24	16	24	32	40	48	56	64	...	...	...	...
25	18	26	35	44	53	61	70	...	...	...	...
26	19	28	38	47	56	66	75	...	...	...	...
27	20	30	41	51	61	71	81	...	...	...	...
28	22	33	44	55	65	76	87	...	...	...	...
29	24	35	47	59	71	82	94	...	...	...	...
30	25	38	50	63	75	88	100	...	...	...	...
31	27	40	54	67	80	94	107	...	...	...	...
32	29	43	57	71	86	100	114	...	...	...	...
33	30	45	61	76	91	106	121	...	...	...	...
34	32	48	65	81	97	113	129	...	...	...	...
35	34	51	68	85	102	119	136	...	...	...	...
36	36	54	72	90	108	126	144	162	180	198	216
37	38	57	76	95	115	134	153	172	191	210	229
38	40	60	80	100	121	141	161	181	201	221	241
39	42	64	85	106	127	148	169	190	212	233	254
40	45	67	89	111	134	156	178	200	223	245	267
41	47	70	94	117	141	164	187	211	234	258	281
42	49	74	98	123	148	172	197	221	246	270	295
43	52	77	103	129	155	180	206	232	258	283	309
44	54	81	108	135	162	188	215	242	269	296	323
45	56	85	113	141	169	197	225	253	282	310	338
46	59	88	118	147	177	206	235	265	294	324	353
47	62	92	123	154	185	215	246	277	308	338	369
48	64	96	128	160	193	225	257	289	321	353	385
49	67	100	134	167	201	234	267	301	334	367	401
50	70	105	139	174	209	244	279	313	348	383	418
51	..	109	145	181	217	253	289	325	362	398	434
52	..	113	151	188	226	263	301	339	376	414	452
53	..	117	156	195	235	273	313	352	391	430	469
54	..	122	162	203	244	284	325	365	406	446	487
55	..	126	168	210	253	295	337	379	421	463	505
56	..	131	175	218	262	305	349	393	436	480	524
57	..	136	181	226	272	317	362	407	453	498	543
58	..	141	187	234	281	328	375	421	468	515	562
59	..	145	194	242	291	339	387	436	484	533	581
60	..	150	200	250	301	351	401	451	501	551	601
61	..	155	207	259	311	362	414	466	518	569	621
62	..	161	214	268	321	375	428	482	535	589	642
63	..	166	221	276	332	387	442	497	553	608	663
64	..	171	228	285	342	399	456	513	570	627	684
65	..	177	235	294	353	412	471	529	588	647	706
66	..	182	243	303	364	425	485	546	607	667	728
67	..	188	250	313	375	438	500	563	625	688	750
68	..	193	257	322	386	450	515	579	643	708	772
69	..	199	265	331	398	464	530	596	663	729	795
70	..	205	273	341	409	477	545	613	682	750	818
71	..	211	281	351	421	491	561	631	702	772	842
72	..	217	289	361	433	505	577	649	722	794	866
73	..	223	297	371	445	519	593	667	742	816	890
74	..	226	305	381	458	534	610	686	763	839	915
75	..	235	313	391	470	548	626	704	783	861	939
76	..	241	322	402	482	563	643	723	804	884	964
77	..	248	330	413	495	578	660	743	825	908	990
78	..	254	339	423	508	593	678	762	847	932	1016
79	..	260	348	434	521	608	695	782	869	956	1043
80	..	267	356	445	534	623	713	802	891	980	1069
81	..	273	365	457	548	639	731	822	913	1004	1096
82	..	280	374	468	561	655	749	842	936	1029	1123
83	..	288	384	479	575	671	767	863	959	1055	1151

Weight of Circular Steel Plates—*Continued*

Dia. In.	Thickness, inches													
	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
84	294	393	491	589	687	786	884	982	1080	1179	1277	1375	1473	1571
85	302	402	503	603	704	805	905	1006	1106	1207	1307	1408	1508	1609
86	309	412	515	618	721	824	926	1029	1132	1235	1338	1441	1544	1647
87	316	422	527	632	738	843	948	1054	1159	1265	1370	1475	1581	1686
88	323	431	539	647	755	863	970	1078	1186	1294	1402	1509	1617	1725
89	331	441	551	661	771	882	992	1102	1212	1323	1433	1543	1653	1763
90	338	451	564	677	789	902	1015	1128	1240	1353	1466	1579	1691	1804
91	345	461	576	692	807	922	1037	1153	1268	1383	1495	1614	1729	1844
92	353	471	589	707	825	943	1060	1178	1296	1414	1532	1649	1767	1885
93	362	482	602	722	843	963	1084	1204	1324	1445	1565	1686	1806	1926
94	369	492	615	738	861	984	1107	1230	1353	1476	1599	1722	1845	1968
95	377	503	628	754	879	1005	1131	1256	1382	1507	1633	1759	1884	2010
96	...	513	641	769	897	1026	1154	1282	1410	1538	1666	1795	1923	2052
97	...	524	654	785	916	1047	1178	1309	1440	1570	1701	1832	1963	2095
98	...	535	668	801	935	1069	1202	1336	1469	1603	1737	1870	2004	2139
99	.....	546	682	818	954	1091	1227	1363	1500	1636	1772	1908	2045	2183
100	...	557	696	835	974	1113	1252	1391	1530	1669	1809	1948	2087	2227
101	...	568	710	852	994	1136	1278	1420	1562	1704	1846	1988	2130	2272
102	...	579	724	869	1014	1158	1303	1448	1593	1738	1882	2027	2172	2317
103	...	591	739	886	1034	1182	1329	1477	1624	1772	1919	2067	2214	2363
104	...	602	753	903	1054	1204	1355	1505	1656	1806	1957	2107	2258	2409
105	...	614	768	921	1074	1228	1381	1534	1688	1841	1994	2148	2302	2455
106	...	626	782	939	1095	1251	1408	1564	1720	1877	2033	2189	2346	2502
107	...	637	797	956	1116	1275	1434	1593	1753	1912	2071	2231	2390	2550
108	...	649	812	974	1136	1299	1461	1623	1786	1948	2110	2273	2435	2598
109	...	662	827	992	1158	1323	1488	1653	1819	1984	2149	2315	2480	2646
110	...	673	842	1010	1179	1347	1516	1684	1853	2029	2189	2358	2526	2695
111	...	686	857	1028	1200	1372	1543	1715	1886	2058	2229	2401	2572	2744
112	...	693	873	1048	1222	1397	1571	1746	1920	2095	2270	2444	2619	2793
113	...	711	889	1066	1244	1422	1599	1777	1955	2133	2310	2488	2666	2844
114	...	724	904	1085	1266	1447	1628	1809	1990	2171	2351	2532	2713	2894
115	...	736	920	1104	1288	1473	1657	1841	2025	2209	2393	2577	2761	2945
116	...	749	936	1124	1311	1498	1686	1873	2060	2247	2435	2622	2809	2997
117	...	762	953	1143	1334	1524	1715	1905	2096	2286	2477	2667	2858	3048
118	...	775	969	1163	1357	1550	1744	1938	2132	2326	2519	2713	2907	3101
119	...	788	985	1183	1380	1577	1774	1971	2168	2365	2562	2759	2956	3154
120	...	802	1002	1203	1403	1604	1804	2005	2205	2406	2606	2807	3007	3208
121	...	815	1019	1223	1426	1630	1834	2038	2242	2445	2649	2853	3057	3260
122	...	829	1036	1243	1450	1657	1864	2072	2279	2486	2693	2900	3107	3314
123	...	842	1053	1263	1474	1685	1895	2106	2316	2527	2737	2948	3159	3369
124	...	856	1070	1284	1498	1712	1926	2140	2354	2568	2782	2996	3210	3424
125	...	870	1087	1305	1522	1740	1957	2175	2392	2610	2827	3045	3262	3480
126	...	884	1105	1326	1547	1768	1989	2210	2431	2652	2872	3093	3315	3535
127	...	898	1122	1347	1571	1796	2020	2245	2469	2694	2918	3143	3367	3592
128	...	912	1140	1368	1596	1824	2052	2280	2508	2736	2964	3192	3420	3649
129	...	926	1158	1390	1621	1853	2085	2316	2548	2779	3011	3242	3474	3706
130	...	941	1176	1411	1646	1882	2117	2352	2587	2822	3058	3293	3528	3764
131	...	955	1194	1433	1672	1911	2150	2389	2627	2866	3105	3344	3583	3822
132	...	970	1213	1455	1698	1940	2183	2425	2668	2910	3153	3395	3638	3880
133	...	985	1231	1477	1723	1970	2216	2462	2708	2954	3200	3446	3693	3939
134	...	1000	1250	1500	1750	1999	2249	2499	2749	2999	3249	3499	3749	3999
135	...	1015	1268	1522	1775	2030	2284	2537	2790	3044	3298	3551	3805	4059
136	...	1029	1286	1543	1900	2057	2315	2572	2829	3086	3344	3601	3858	4115
137	...	1044	1300	1560	1820	2088	2340	2600	2860	3132	3380	3640	3900	4176
138	...	1059	1321	1585	1849	2118	2378	2642	2906	3177	3435	3699	3963	4237
139	...	1075	1344	1613	1882	2150	2419	2688	2957	3225	3494	3763	4032	4300
140	...	1090	1363	1635	1908	2180	2453	2725	2998	3270	3543	3815	4088	4361
141	...	1106	1383	1659	1936	2212	2489	2765	3042	3318	3595	3871	4148	4424
142	...	1122	1402	1682	1963	2243	2524	2804	3084	3365	3645	3926	4206	4487
143	...	1137	1422	1706	1991	2275	2560	2844	3128	3412	3697	3982	4266	4550
144	...	1153	1442	1730	2019	2307	2596	2884	3172	3460	3749	4038	4326	4614
145	...	1169	1462	1754	2047	2339	2632	2924	3216	3508	3801	4094	4386	4678
146	...	1186	1482	1778	2075	2371	2668	2964	3260	3557	3853	4150	4446	4743
147	...	1202	1503	1803	2104	2404	2705	3005	3306	3606	3907	4207	4508	4808
148	...	1218	1523	1828	2132	2437	2741	3046	3351	3655	3960	4264	4569	4874
149	...	1235	1544	1852	2161	2470	2778	3087	3396	3705	4013	4322	4631	4940
150	...	1251	1565	1877	2190	2503	2816	3129	3442	3754	4068	4381	4694	5006

Permissible Overweights of Plates Ordered to Thickness

Ordered Thickness, In.	Permissible Excess in Average Weights per Square Foot of Plates for Widths Given, Expressed in Percentages of Nominal Weights									Ordered Thickness, In.
	Under 48 in.	48 to 60 in., excl.	60 to 72 in., excl.	72 to 84 in., excl.	84 to 96 in., excl.	96 to 108 in., excl.	108 to 120 in., excl.	120 to 132 in., excl.	132 in. or over	
Under 1/8	9	10	12	14	.....	.....	..	..	..	Under 1/8
1/8 to 3/16 excl.	8	9	10	12	.....	.....	..	..	..	1/8 to 3/16 excl.
3/16 to 1/4 "	7	8	9	10	12	.....	..	....	..	3/16 to 1/4 "
1/4 to 5/16 "	6	7	8	9	10	12	14	16	19	1/4 to 5/16 "
5/16 to 3/8 "	5	6	7	8	9	10	12	14	17	5/16 to 3/8 "
3/8 to 7/16 "	4.5	5	6	7	8	9	10	12	15	3/8 to 7/16 "
7/16 to 1/2 "	4	4.5	5	6	7	8	9	10	13	7/16 to 1/2 "
1/2 to 5/8 "	3.5	4	4.5	5	6	7	8	9	11	1/2 to 5/8 "
5/8 to 3/4 "	3	3.5	4	4.5	5	6	7	8	9	5/8 to 3/4 "
3/4 to 1 "	2.5	3	3.5	4	4.5	5	6	7	8	3/4 to 1 "
1 or over	2.5	2.5	3	3.5	4	4.5	5	6	7	1 or over

Permissible Variations of Plates Ordered to Weight

Ordered Weight, Lb. per Sq. Ft.	Permissible Variations in Average Weights per Square Foot of Plates for Widths Given, Expressed in Percentages of Ordered Weights																		Ordered Weight, Lb. per Sq. Ft.
	Under 48 in.,		48 to 60 in., excl.		60 to 72 in., excl.		72 to 84 in., excl.		84 to 96 in., excl.		96 to 108 in., excl.		108 to 120 in., excl.		120 to 132 in., excl.		132 in. or over		
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	
Under 5	5	3	5.5	3	6	3	7	3	...	...	...	...	...	...	...	...	...	...	Under 5
5 to 7.5 excl.	4.5	3	5	3	5.5	3	6	3	...	...	...	...	...	...	...	...	...	...	5 to 7.5 excl.
7.5 to 10 "	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	...	...	...	...	7.5 to 10 "
10 to 12.5 "	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	9	3	10 to 12.5 "
12.5 to 15 "	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	12.5 to 15 "
15 to 17.5 "	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	15 to 17.5 "
17.5 to 20 "	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	17.5 to 20 "
20 to 25 "	2	2	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	20 to 25 "
25 to 30 "	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	5	3	25 to 30 "
30 to 40 "	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	30 to 40 "
40 or over	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	40 or over

Note.—The weight per square foot of individual plates shall not vary from the ordered weight by more than 1½ times the amount given in this table.

Riveted Joints

A. S. M. E. Code

Formulae for Determining Joint Efficiencies

T = the tensile strength of plate per square inch, in pounds, or 55,000 lb.

S = the shearing strength of rivet material per square inch, in pounds, where subjected to single shear, or 44,000 lb.

$2S$ = the shearing strength of rivet material per square inch, in pounds, where subjected to double shear, or 88,000 lb.

C = the crushing strength of plate per square inch, in pounds, the projected area of contact between the plate and rivets being used, and 95,000 lb. representing this value.

P = the pitch of rivets, or a unit section length of joint, in inches.

d = the driven diameter of rivets, or the diameter of rivet hole, in inches.

t = the thickness of the plate, in inches.

t_1 = the thickness of butt straps, in inches.

Single-riveted Lap Joint,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{0.7854d^2S}{PtT}$$

$$E = \frac{tdC}{PtT}$$

Double-riveted Lap Joint,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{2 \times 0.7854d^2S}{PtT}$$

$$E = \frac{2tdC}{PtT}$$

Triple-riveted Lap Joint,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{3 \times 0.7854d^2S}{PtT}$$

$$E = \frac{3tdC}{PtT}$$

Double-riveted Butt Joint with Straps of Unequal Width,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{[P - 2d]tT + 0.7854d^2S}{PtT}$$

$$E = \frac{[P - 2d]tT + t_1dC}{PtT}$$

$$E = \frac{2 \times 0.7854d^22S + 0.7854d^2S}{PtT}$$

$$E = \frac{2tdC + t_1dC}{PtT}$$

$$E = \frac{2tdC + 0.7854d^2S}{PtT}$$

Riveted Joints (Continued)

Triple-riveted Butt Joint with Straps of Unequal Width,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{[P - 2d]tT + 0.7854d^2S}{PtT}$$

$$E = \frac{[P - 2d]tT + t_1dC}{PtT}$$

$$E = \frac{4 \times 0.7854d^2 2S + 0.7854d^2S}{PtT}$$

$$E = \frac{4tdC + t_1dC}{PtT}$$

$$E = \frac{4tdC + 0.7854d^2S}{PtT}$$

Quadruple-riveted Butt Joint with Straps of Unequal Width,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{[P - 4d]tT + 3 \times 0.7854d^2S}{PtT}$$

$$E = \frac{[P - 4d]tT + 3t_1dC}{PtT}$$

$$E = \frac{8 \times 0.7854d^2 2S + 3 \times 0.7854d^2S}{PtT}$$

$$E = \frac{8tdC + 3t_1dC}{PtT}$$

$$E = \frac{8tdC + 3 \times 0.7854d^2S}{PtT}$$

Quintuple-riveted Butt Joint with Straps of Unequal Width,

$$E = \frac{[P - d]tT}{PtT}$$

$$E = \frac{[P - 8d]tT + 7 \times 0.7854d^2S}{PtT}$$

$$E = \frac{[P - 8d]tT + 7t_1dC}{PtT}$$

$$E = \frac{16 \times 0.7854d^2 2S + 7 \times 0.7854d^2S}{PtT}$$

$$E = \frac{16tdC + 7t_1dC}{PtT}$$

$$E = \frac{16tdC + 7 \times 0.7854d^2S}{PtT}$$

The true joint efficiency is the least of these values.

Shearing and Bearing Values of Rivets in Pounds

Size of Rivet, Inch.	Area of Rivet, Square Inch.	UNIT STRESSES, POUNDS PER SQUARE INCH.						
		Shearing	8,000	9,000	10,000	11,000	12,000	13,500	13,500
		Bearing	16,000	18,000	20,000	22,000	24,000	27,000	30,000
3/8	.1104	Single Shear	880	990	1100	1210	1320	1490	1490
		Bearing, Inch.							
		3/16	1130	1270	1410	1550	1690	1900	2110
		1/4	1500	1690	1880	2060	2250	2530	2810
		Double Shear	1770	1990	2210	2430	2650	2980	2980
1/2	.1963	Single Shear	1570	1770	1960	2160	2360	2650	2650
		Bearing, Inch.							
		3/16	*1500*	*1690*	*1880*	*2060*	*2250*	*2530*	2810
		1/4	2000	2250	2500	2750	3000	3380	3750
		5/16	2500	2810	3130	3440	3750	4220	4690
		3/8	3000	3380	3750	4130	4500	5060	*5630*
		Double Shear	3140	3530	3930	4320	4710	5300	5300
5/8	.3068	Single Shear	2450	2760	3070	3370	3680	4140	4140
		Bearing, Inch.							
		3/16	*1880*	*2110*	*2340*	*2580*	*2810*	*3160*	*3520*
		1/4	2500	2810	3130	3440	3750	4220	4690
		5/16	3130	3520	3910	4300	4690	5270	5860
		3/8	3750	4220	4690	5160	5630	6330	7030
		7/16	4380	4920	5470	6020	6560	7380	8200
		Double Shear	4910	5520	6140	6750	7360	8280	8280
3/4	.4418	Single Shear	3530	3980	4420	4860	5300	5960	5960
		Bearing, Inch.							
		1/4	*3000*	*3380*	*3750*	*4130*	*4500*	*5060*	*5630*
		5/16	3750	4220	4690	5160	5630	6330	7030
		3/8	4500	5060	5630	6190	6750	7590	8440
		7/16	5250	5910	6560	7220	7880	8860	9840
		1/2	6000	6750	7500	8250	9000	10130	11250
		9/16	6750	7590	8440	9280	10130	11390	*12660*
		Double Shear	7070	7950	8840	9720	10600	11930	11930
7/8	.6013	Single Shear	4810	5410	6010	6610	7220	8120	8120
		Bearing, Inch.							
		1/4	*3500*	*3940*	*4380*	*4810*	*5250*	*5910*	*6560*
		5/16	*4380*	*4920*	*5470*	*6020*	*6560*	*7380*	8200
		3/8	5250	5910	6560	7220	7880	8860	9840
		7/16	6130	6890	7660	8420	9190	10340	11480
		1/2	7000	7880	8750	9630	10500	11810	13130
		9/16	7880	8860	9840	10830	11810	13290	14770
		5/8	8750	9840	10940	12030	13130	14770	*16410*
		11/16	*9630*	*10830*	12030	13230	14440	16240	*18050*
		Double Shear	9620	10820	12030	13230	14430	16240	16240

Bearing values given in *italics* are either smaller than single shear or larger than double shear.

Shearing and Bearing Values of Rivets in Pounds

Size of Rivet, Inch.	Area of Rivet, Square Inch.	UNIT STRESSES, POUNDS PER SQUARE INCH.						
		Shearing.....	8,000	9,000	10,000	11,000	12,000	13,500	13,500
		Bearing.....	16,000	18,000	20,000	22,000	24,000	27,000	30,000
		Single Shear	6280	7070	7850	8640	9420	10600	10600
		Bearing, Inch.							
		¼	*4000*	*4500*	*5000*	*5500*	*6000*	*6750*	*7500*
		5/16	*5000*	*5630*	*6250*	*6880*	*7500*	*8440*	*9380*
		⅜	*6000*	*6750*	*7500*	*8250*	*9000*	*10130*	11250
		7/16	7000	7880	8750	9630	10500	11810	13130
1	.7854	½	8000	9000	10000	11000	12000	13500	15000
		9/16	9000	10130	11250	12380	13500	15190	16880
		⅝	10000	11250	12500	13750	15000	16880	18750
		11/16	11000	12380	13750	15130	16500	18560	20630
		¾	12000	13500	15000	16500	18000	20250	*22500*
		Double Shear	12570	14140	15710	17280	18850	21210	21210
		Single Shear	7950	8950	9940	10930	11930	13420	13420
		Bearing, Inch.							
		¼	*4500*	*5060*	*5630*	*6190*	*6750*	*7590*	*8440*
		5/16	*5630*	*6330*	*7030*	*7730*	*8440*	*9490*	*10550*
		⅜	*6750*	*7590*	*8440*	*9280*	*10130*	*11390*	*12660*
		7/16	*7880*	*8860*	*9840*	*10830*	*11810*	*13290*	14770
		½	9000	10130	11250	12380	13500	15190	16880
1⅛	.9940	9/16	10130	11390	12660	13920	15190	17090	18980
		⅝	11250	12660	14060	15470	16880	18980	21090
		11/16	12380	13920	15470	17020	18560	20880	23200
		¾	13500	15190	16880	18560	20250	22780	25310
		13/16	14630	16450	18280	20110	21940	24680	*27420*
		⅞	15750	17720	19690	21660	23630	26580	*29530*
		Double Shear	15900	17890	19880	21870	23860	26840	26840
		Single Shear	9820	11040	12270	13500	14730	16570	16570
		Bearing, Inch.							
		¼	*5000*	*5630*	*6250*	*6880*	*7500*	*8440*	*9380*
		5/16	*6250*	*7030*	*7810*	*8590*	*9380*	*10550*	*11720*
		⅜	*7500*	*8440*	*9380*	*10310*	*11250*	*12660*	*14060*
		7/16	*8750*	*9840*	*10940*	*12030*	*13130*	*14770*	*16410*
		½	10000	11250	12500	13750	15000	16880	18750
		9/16	11250	12660	14060	15470	16880	18980	21090
1¼	1.2272	⅝	12500	14060	15630	17190	18750	21090	23440
		11/16	13750	15470	17190	18910	20630	23200	25780
		¾	15000	16880	18750	20630	22500	25310	28130
		13/16	16250	18280	20310	22340	24380	27420	30470
		⅞	17500	19690	21880	24060	26250	29530	32810
		15/16	18750	21090	23440	25780	28130	31640	*33160*
		Double Shear	19640	22090	24540	27000	29450	33130	33130

Bearing values given in *italics* are either smaller than single shear or larger than double shear.

Length of Rivets Required for Various Grips Including Amount Necessary to Form One Head

LENGTHS, IN INCHES, TO FORM BUTTON HEADS.

Grip, Inch.	DIAMETER OF RIVET, INCH.							Grip, Inch.	DIAMETER OF RIVET, INCH.				
	½	⅝	¾	⅞	1	1⅛	1¼		¾	⅞	1	1⅛	1¼
½	1½	1¾	1⅞	2	2⅛	...	...	4½	6⅜	6½	6½	6⅝	6¾
⅝	1⅝	1⅞	2	2⅛	2¼	...	...	4⅝	6½	6⅝	6⅝	6¾	6⅞
¾	1¾	2	2⅛	2¼	2⅜	...	...	4¾	6⅝	6¾	6¾	6⅞	7
⅞	1⅞	2⅛	2¼	2⅜	2½	...	...	4⅞	6¾	7	7	7	7⅛
1	2	2¼	2⅜	2½	2⅝	2¾	2⅞	5	7	7⅛	7⅛	7¼	7¼
1⅛	2⅛	2⅜	2½	2⅝	2¾	2⅞	3	5⅛	7⅛	7¼	7¼	7⅜	7⅜
1¼	2¼	2½	2⅝	2¾	2⅞	3	3⅛	5¼	7¼	7⅜	7⅜	7½	7½
1⅜	2⅜	2⅝	2¾	2⅞	3	3⅛	3¼	5⅜	7⅜	7½	7½	7⅝	7¾
1½	2½	2¾	2⅞	3	3⅛	3¼	3⅜	5½	7½	7⅝	7⅝	7¾	7⅞
1⅝	2⅝	2⅞	3	3⅛	3¼	3⅜	3½	5⅝	7⅝	7¾	7¾	7⅞	8
1¾	2¾	3	3⅛	3⅜	3⅜	3½	3⅝	5¾	7¾	7⅞	7⅞	8	8⅛
1⅞	2⅞	3⅛	3¼	3½	3½	3⅝	3⅞	5⅞	7⅞	8	8	8⅛	8¼
2	3⅛	3⅜	3½	3⅝	3¾	3⅞	4	6	...	8⅛	8¼	8¼	8⅜
2⅛	3¼	3½	3⅝	3¾	3⅞	4	4⅛	6⅛	...	8¼	8⅜	8⅜	8½
2¼	3⅜	3⅝	3¾	3⅞	4	4⅛	4¼	6¼	...	8⅜	8½	8½	8⅝
2⅜	3½	3¾	3⅞	4	4⅛	4¼	4⅜	6⅜	...	8½	8⅝	8⅝	8¾
2½	3⅝	3⅞	4	4⅛	4¼	4⅜	4½	6½	...	8⅝	8¾	8¾	8⅞
2⅝	3¾	4	4⅛	4¼	4⅜	4½	4⅝	6⅝	...	8¾	8⅞	9	9⅛
2¾	3⅞	4⅛	4¼	4½	4½	4⅝	4¾	6¾	...	8⅞	9	9⅛	9¼
2⅞	4	4⅜	4½	4⅝	4⅝	4¾	4⅞	6⅞	...	9	9⅛	9¼	9⅜
3	4¼	4⅝	4¾	4⅞	4⅞	5	5⅛	7	...	...	9⅜	9⅜	9½
3⅛	4⅜	4¾	4⅞	5	5	5⅛	5¼	7⅛	...	...	9½	9½	9⅝
3¼	4½	4⅞	5	5⅛	5⅛	5¼	5⅜	7¼	...	...	9⅝	9⅝	9¾
3⅜	4⅝	5	5⅛	5¼	5¼	5⅜	5½	7⅜	...	...	9¾	9¾	9⅞
3½	4¾	5⅛	5¼	5⅜	5⅜	5½	5⅝	7½	...	...	9⅞	9⅞	10
3⅝	4⅞	5¼	5⅜	5⅝	5½	5⅝	5¾	7⅝	...	...	10	10	10⅛
3¾	5	5⅜	5½	5¾	5⅝	5¾	5⅞	7¾	...	...	10⅛	10¼	10⅜
3⅞	5⅛	5½	5⅝	5⅞	5¾	5⅞	6	7⅞	...	...	10¼	10⅜	10½
4	...	5¾	5¾	6	6	6⅛	6⅛	8	...	...	....	10½	10⅝
4⅛	...	5⅞	5⅞	6⅛	6⅛	6¼	6¼	8⅛	...	...	....	10⅝	10¾
4¼	..	6	6	6¼	6¼	6⅜	6⅜	8¼	...	...	....	10¾	10⅞
4⅜	...	6⅛	6¼	6⅜	6⅜	6½	6⅝	8⅜	...	...	....	10⅞	11

Amount in Inches to be subtracted from above Lengths to form Countersunk Heads.

	½	½	⅝	¾	⅞	1	1⅛		⅝	¾	⅞	1	1⅛

Weights of Steel Rivets with Button Heads for 100 Rivets, in Pounds

Length Under Head, Inches.	DIAMETER OF RIVET, INCHES.									
	½	9/16	⅝	11/16	¾	13/16	⅞	1	1⅛	1¼
1	10.0	15.2	18.3	21.7	26.6	...	...	...	...	...
1¼	11.4	16.8	20.3	24.5	29.5	37.0	46	60	...	...
1½	12.8	18.4	22.4	27.3	32.4	40.2	50	65	98	133
1¾	14.2	20.0	24.4	30.1	35.3	43.5	54	69	104	141
2	15.6	21.6	26.5	32.9	38.2	47.0	58	74	110	149
2¼	17.0	23.2	28.6	35.7	41.1	50.3	62	80	118	157
2½	18.4	24.8	30.6	38.5	44.0	53.5	66	86	124	165
2¾	19.8	26.4	32.7	41.3	46.9	56.8	70	92	130	173
3	21.2	28.0	34.7	44.1	49.8	60.0	74	98	137	181
3¼	22.6	29.7	36.8	46.9	52.7	63.3	78	103	144	189
3½	24.0	31.5	38.9	49.7	55.6	66.5	82	108	151	197
3¾	25.4	33.3	40.9	52.5	58.5	69.8	86	113	158	205
4	26.8	35.2	43.0	55.3	61.4	73.0	90	118	165	213
4¼	28.2	36.9	45.0	58.1	64.3	76.3	94	124	172	221
4½	29.6	38.6	47.1	60.9	67.2	79.5	98	130	179	229
4¾	31.0	40.3	49.2	63.7	70.1	82.8	102	136	186	237
5	32.4	42.0	51.2	66.5	73.0	86.0	106	142	193	245
5¼	33.8	43.7	53.3	69.2	75.9	89.3	110	148	200	254
5½	35.2	45.4	55.3	72.0	78.8	92.5	114	154	206	263
5¾	36.6	47.1	57.4	74.8	81.7	95.7	118	160	212	272
6	38.0	48.8	59.5	77.6	84.6	99.0	122	166	218	281
6½	40.8	52.0	63.6	83.3	90.4	105.5	130	177	231	297
7	43.6	55.2	67.7	88.9	96.2	112.0	138	188	245	314

WEIGHTS OF BUTTON HEADS AS MANUFACTURED, FOR 100 HEADS, IN POUNDS.

Button Heads.	DIAMETER OF RIVET, INCHES.									
	½	9/16	⅝	11/16	¾	13/16	⅞	1.	1⅛	1¼
Pounds per hundred.	3.9	6.0	7.9	11.3	14.1	17.7	21.6	31.3	45.5	63.6

Tensile Stress of Bolts

Diameter of Bolt in Ins.	Area of Bottom of Thread	At 7,000 Lbs. per Sq. In.	At 10000 Lbs. per Sq. In.	At 12000 Lbs. per Sq. In.	At 15000 Lbs. per Sq. In.	At 20000 Lbs. per Sq. In.
1/2	.125	875	1250	1500	1875	2500
5/8	.196	1372	1960	2350	2940	3920
3/4	.30	2100	3000	3600	4500	6000
7/8	.42	2940	4200	5040	6300	8400
1	.55	3850	5500	6600	8250	11000
1 1/8	.69	4830	6900	8280	10350	13800
1 1/4	.78	5460	7800	9300	11700	15600
1 3/8	1.06	7420	10600	12720	15900	21200
1 1/2	1.28	8960	12800	15360	19200	25600
1 5/8	1.53	10710	15300	18360	22950	30600
1 3/4	1.76	12320	17600	21120	26400	35200
1 7/8	2.03	14210	20300	24360	30450	40600
2	2.30	16100	23000	27600	34500	46000
2 1/4	3.12	21840	31200	37440	46800	62400
2 1/2	3.70	25900	37000	44400	55500	74000

The breaking strength of good American bolt iron is usually taken at 50000 pounds per square inch, with an elongation of 15 percent before breaking. It should not set under a strain of less than 25000 pounds. The proof strain is 20000 pounds per square inch and beyond this amount iron should never be strained in practice.

Safe Load of Bolts

Diameter of Bolt in Inches	Safe Load in Pounds	Diameter of Bolt in Inches	Safe Load in Pounds
1/2	1000	1 1/4	8050
5/8	1800	1 3/8	10000
3/4	2750	1 1/2	11800
7/8	3800	1 3/4	15750
1	5000	2	20800
1 1/8	6250		

Weights of Bolts with Square Heads and Nuts for 100 Bolts in Pounds

Length Under Head, Inches.	DIAMETER OF BOLT, INCHES.								
	¼	5/16	⅜	½	⅝	¾	⅞	1	1⅛
1	2.6	4.7	7.5	16.1	29.6	47.2	72.7	....	....
1¼	3.0	5.2	8.3	17.5	31.4	50.3	77.0	....	....
1½	3.3	5.8	9.1	18.9	33.6	52.9	80.6	....	....
1¾	3.6	6.3	9.8	20.3	35.8	55.5	83.5	....	....
2	4.0	6.8	10.6	21.7	37.9	58.7	87.8	126.7	180.4
2¼	4.3	7.3	11.4	23.1	40.1	61.8	92.0	131.4	186.4
2½	4.6	7.8	12.1	24.5	42.3	64.9	96.3	137.0	193.4
2¾	5.0	8.4	12.9	25.9	44.4	68.1	100.5	141.6	198.2
3	5.3	8.9	13.7	27.2	46.6	71.2	104.8	147.2	205.3
3½	6.0	10.0	15.1	29.8	50.6	77.4	113.3	158.3	218.2
4	6.7	11.1	16.7	32.5	54.9	83.7	121.8	169.4	232.3
4½	7.4	12.2	18.2	35.3	59.3	89.4	129.7	179.7	245.3
5	8.1	13.3	19.8	38.1	63.6	95.7	138.2	190.8	259.4
5½	8.8	14.4	21.4	40.9	68.0	102.0	146.7	202.0	273.5
6	9.5	15.4	22.9	43.7	72.3	108.2	155.3	213.1	287.5
6½	10.2	16.5	24.5	46.5	76.7	114.5	163.8	224.2	301.6
7	10.9	17.6	26.1	49.2	81.0	120.7	172.3	235.3	315.7
7½	11.6	18.7	27.6	52.0	85.3	127.0	180.8	246.5	329.8
8	12.3	19.8	29.2	54.8	89.7	133.2	189.3	257.6	343.9
9	....	....	32.3	60.1	98.0	145.2	205.7	278.9	370.9
10	....	....	35.4	65.7	106.7	157.8	222.7	301.2	399.1
12	....	....	41.7	76.8	124.1	182.8	256.8	345.7	455.4
14	....	....	....	87.4	141.1	207.8	290.2	388.5	510.6
16	....	....	....	98.5	158.5	232.9	324.3	433.0	567.0
18	....	....	....	109.6	175.8	257.9	358.3	477.5	623.3
20	....	....	....	120.8	193.2	282.9	392.4	522.0	679.6
Per Inch Additional.	1.4	2.2	3.1	5.6	8.7	12.5	17.0	22.3	28.2

WEIGHTS OF NUTS AND BOLT HEADS, IN POUNDS, FOR ONE HEAD AND ONE NUT.

DIAMETER OF BOLT, INCHES.	¼	5/16	⅜	½	⅝	¾	⅞
Square Head and Nut	.0149	.0288	.0495	.116	.225	.367	.584
Hexagon Head and Nut	.0129	.0251	.0430	.101	.194	.318	.505
DIAMETER OF BOLT, INCHES.	**1**	**1⅛**	**1¼**	**1⅜**	**1½**	**1¾**	**2**
Square Head and Nut	.874	1.31	1.79	2.37	3.06	4.86	7.22
Hexagon Head and Nut	.755	1.13	1.54	2.05	2.64	4.19	6.22
Weight of Shank per Inch	.223	.282	.348	.421	.501	.682	.890

All weights are theoretical.

Theoretical Bursting Pressure—Cylindrical Shells

Joint Efficiency—100 per cent

Tensile Strength of Steel—55,000 pounds per square inch

Inside Dia.	THICKNESS																							
	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2	17/32	9/16	19/32	5/8	21/32	11/16	23/32	3/4	25/32	13/16	27/32	7/8
24	1146	1289	1432	1575	1718	1861	2005	2148	2292	....	....	....	....	....	....	....	....	....	....	....	....
26	1058	1190	1322	1452	1587	1718	1850	1984	2117	....	....	....	....	....	....	....	....	....	....	....	....
28	982	1104	1228	1350	1473	1596	1718	1841	1965	2086	2209	....	....	....	....	....	....	....	....	....	....
30	916	1030	1146	1260	1375	1489	1602	1718	1833	1947	2061	....	....	....	....	....	....	....	....	....	....
32	859	967	1074	1181	1289	1397	1502	1611	1719	1827	1934	2041	2148	....	....	....	....	....	....	....	....
34	809	910	1011	1111	1213	1314	1415	1517	1618	1718	1820	1921	2022	....	....	....	....	....	....	....	....
36	764	859	955	1050	1146	1241	1336	1432	1528	1623	1718	1814	1910	2004	2100	....	....	....	....	....	....
38	723	814	904	995	1085	1176	1266	1358	1446	1539	1629	1718	1808	1900	1990	....	....	....	....	....	....
40	687	773	859	945	1031	1117	1203	1290	1374	1460	1547	1633	1718	1805	1890	1975	2062	....	....	....	....
42	654	736	818	900	982	1067	1146	1228	1308	1391	1472	1556	1636	1718	1800	1882	1964	....	....	....	....
44	625	703	781	859	937	1015	1094	1171	1250	1328	1406	1485	1562	1640	1718	1796	1874	1952	2030	....	....
46	598	672	747	822	897	971	1046	1121	1196	1270	1344	1420	1494	1569	1644	1718	1794	1868	1942	....	....
48	573	644	716	788	859	931	1001	1073	1146	1218	1288	1361	1432	1503	1575	1647	1718	1790	1862	1933	2002
50	550	619	687	756	825	894	962	1031	1100	1169	1238	1307	1374	1444	1512	1581	1650	1718	1788	1856	1924
52	529	595	661	727	793	859	925	992	1058	1123	1190	1257	1322	1389	1453	1520	1586	1652	1718	1785	1850
54	509	573	636	700	764	827	891	955	1019	1082	1146	1210	1272	1338	1400	1464	1528	1591	1654	1718	1782
60	458	516	573	630	687	745	802	859	917	974	1032	1089	1146	1202	1260	1318	1375	1431	1490	1547	1603
66	417	469	521	573	625	677	729	782	834	886	938	990	1042	1093	1146	1198	1250	1301	1354	1407	1458
72	382	430	477	525	573	621	668	716	764	812	860	907	954	1002	1050	1098	1146	1193	1242	1290	1336
78	352	397	441	484	529	573	617	661	703	749	794	838	882	926	968	1013	1058	1101	1146	1190	1234
84	327	368	409	450	491	532	573	614	655	696	736	778	818	860	900	941	982	1022	1064	1105	1146
90	305	344	382	420	459	496	535	573	611	650	688	726	764	802	840	879	917	955	993	1031	1070
96	286	322	358	394	430	465	501	537	573	609	645	681	716	752	788	824	859	895	931	968	1002
102	270	303	337	371	405	438	472	506	539	573	607	641	674	708	742	775	810	843	876	910	944
108	254	287	318	350	382	414	445	478	509	541	573	605	636	669	700	732	764	796	827	860	891
114	241	272	302	332	362	392	422	453	483	513	543	573	603	634	664	694	724	754	784	814	844
120	229	258	286	315	344	372	401	430	458	487	516	545	573	602	630	659	687	716	745	774	802
126	218	246	273	300	328	355	382	409	436	464	491	518	546	573	600	628	655	683	710	737	764
132	208	234	260	287	312	339	365	391	417	443	469	495	521	547	573	599	625	651	677	704	729
138	199	224	249	274	299	324	349	374	398	424	449	474	498	524	548	573	598	623	648	673	698
144	191	215	239	262	287	310	334	358	382	406	430	454	478	501	525	549	573	597	621	645	668

The safe working pressure is found by dividing the above bursting pressures by the factor of safety and multiplying the quotient by the efficiency of the longitudinal joint. Example: Shell 60 in. diam. x ½ in. thick, factor of safety 5; butt and double strap joint, double riveted efficiency 81.3%; $\frac{917}{5} \times .813 = 149$ lbs.

Formulae for Design of Heads Under Pressure

Dished Heads

A. S. M. E. Code for Unfired Pressure Vessels (Revised, 1929)*

U-36. The thickness of a blank unstayed dished head with the pressure on the concave side, when it is a segment of a sphere shall be calculated by the following formula.

$$t = \frac{8.33 \times P \times L}{2 \times TS}$$

where t = thickness of plate, in.

P = maximum allowable working pressure, lb. per sq. in.

TS = tensile strength, lb. per sq. in.

L = radius to which the head is dished, measured on the concave side of the head, in.

Where two radii are used, the longer shall be taken as the value of L in the formula.

When a dished head has a manhole or access opening, that exceeds 6 in. in any dimension, the thickness shall be increased by not less than 15 per cent of the required thickness for a blank head computed by the above formula, but in no case less than $\frac{1}{8}$ in. additional thickness over a blank head. Where a dished head has a flanged opening supported by an attached flue, an increase in thickness over that for a blank head is not required. If more than one manhole is inserted in a head, the thickness of which is calculated by this rule, the minimum distance between the openings shall be not less than one-fourth of the outside diameter of the head.

The radius to which the head is dished shall not be greater than the diameter of the shell to which the head is attached.

Where the radius L to which the head is dished is less than 80 per cent of the diameter of the shell the thickness of a head with a manhole opening shall be at least that found by making L equal to 80 per cent of the diameter of the shell. This thickness shall be the minimum thickness of a head with a manhole opening for any form of head.

A blank head of a semi-elliptical form in which the minor axis of the ellipse is at least one-half the diameter of the shell shall be made at least as thick, as the required thickness of a seamless shell of the same diameter. If a flanged-in manhole, which meets the code requirements, is placed in an elliptical head the thickness shall be the same as for an ordinary dished head with a radius equal to 0.8 the diameter of the shell and with the added thickness for the manhole.

The diameter of the shell to be used in applying these rules shall be the inner diameter of the shell for a head fitted to the inside of the shell, and the outer diameter of the shell for a head fitted to the outside of the shell.

Unstayed dished heads with the pressure on the convex side shall have a maximum allowable working pressure equal to 60 per cent of that for heads of the same dimensions with the pressure on the concave side.

**A. S. M. E. Code complies with Pennsylvania regulations and those of other States.*

If a nozzle type manhole which meets the code requirements is placed on a elliptical head, the thickness of the head shall be the same as for an ordinary elliptical head providing, in the case of saddle type riveted flanged manholes, the provisions of Par. U-56 are complied with. In the case of nozzle-type manholes forge-welded to the head, a reinforcing collar of the thickness required in Par. U-56 shall be drawn simultaneously with the drawing of the flange in the head.

U 37. When dished heads are of a less thickness than called for by Par. U-36 they shall be stayed as flat surfaces, no allowance being made in such staying for the holding power due to the spherical form unless all of the following conditions are met:

a That they be at least two-thirds as thick as called for by the rules for unstayed dished heads.

b That they be at least 7/8 in. thick.

c That through stays be used attached to the dished head by outside and inside nuts.

d That the maximum allowable working pressure shall not exceed that calculated by the rules for an unstayed dished head plus the pressure corresponding to the strength of the stays or braces secured by the formula for braced or stayed surfaces given in Par. U-40 using 70 for the value of C.

If a dished head is formed with a flattened spot or surface, the diameter of the flat spot shall not exceed that allowable for flat heads as given by the formula in Par. U-36.

Formulae for Design of Shells Under Pressure

A.S.M.E. Code for Unfired Pressure Vessels (Revised 1929)

U-17. For all pressure vessels the minimum thicknesses of shell plates, heads and dome plates after flanging shall be as follows:

When the Diameter of Shell is:

16 in. and under 1/8 in.	Over 36 in. to 54 in. 5/16 in.
Over 16 in. to 24 in., 3/16 in.	Over 54 in. to 72 in. 3/8 in.
Over 24 in. to 36 in., 1/4 in.	Over 72 in. 1/2 in.

except that for riveted construction the minimum thickness shall be 3/16 in.

U-20. For Internal Pressure. The maximum allowable working pressure on the shell of a pressure vessel shall be determined by the strength of the weakest course, computed from the thickness of the plate, the efficiency of the longitudinal joint, the inside diameter of the course, and the maximum allowable unit working stress.

$$\frac{S \times t \times E}{R} = \text{maximum allowable working pressure, lb. per sq. in.}$$

where

S = maximum allowable unit working stress in lb. per sq. in. 11,000 lb. per sq. in. for steel plate stamped 55,000 lb. per sq. in., 10,000 lb. per sq. in. for steel plate stamped less than 55,000 lb. per sq. in., and for material used in seamless shells, one-fifth of the minimum of the specified range of the tensile strength of the material.

t = minimum thickness of shell plates in weakest course, in.

E = efficiency of riveted longitudinal joint.

R = inside radius of the weakest course of the shell, in., provided the thickness of the shell does not exceed 10 per cent of the radius. If the thickness is over 10 per cent of the radius, the outer radius shall be used.

Note: When the safe working pressure for welded or brazed vessels is to be determined, E will be omitted from the formula and the values for S in Pars. U-68, U-82, or U-94 will be substituted for the values given above. For seamless shells, E equals 100 per cent.

Flat Steel Rectangular Plates

To Find Thickness of Plate Required

Pressure given—*Based on Grashof's Formula*

$$t = 0.62 \sqrt{\frac{W \times L \times l}{S(L^2 \times l^2)}}$$

P = Load in lbs. per sq. in.
W = Total load in pounds
L = Long span of distance between supports in inches
l = Short span of distance between supports in inches
S = Fiber stress of steel in lbs. per sq. in.
t = Thickness of plate in inches

Circular Flat Plates

To Find Thickness of Plate Required

Use same notation given for rectangular plates
Based on Reuleaux's Formulae

$$t = 0.46 \sqrt{\frac{W}{S}}$$

These formulae are for plates firmly secured all around the edges, with the load uniformly distributed over the unsupported area.

Unit Tensile Stress on Hollow Cylindrical Tank Walls

Based on Boyd's Formula

Girth Seam

$$S = \frac{PD}{4t}$$

Longitudinal Seam

$$S = \frac{PD}{2t}$$

S = Tensile stress in lbs. per sq. in.
P = Working Pressure in lbs. per sq. in.
D = Dia. of tank in inches
t = Thickness of tank shell in inches

Shells for Pressure Vessels

Commonwealth of Massachusetts
Department of Public Safety
(1929 Air Tank Regulations)

To determine maximum allowable pressure.

1. The maximum pressure to be allowed on a steel or wrought-iron shell or drum of a tank shall be determined from the minimum thickness of the shell plates, the lowest tensile strength stamped on the plates by the plate manufacturer, the efficiency of the longitudinal joint, the inside diameter of the outside course, and a factor of safety of not less than five (5), the formula being:

$$\frac{T.S. \times t \times \%}{R \times F.S.} = \text{maximum allowable working pressure per square inch, in pounds.}$$

T. S. = tensile strength of shell plates, in pounds.

t = minimum thickness of shell plates, in inches.

% = efficiency of longitudinal joint or ligament between tube holes, whichever is the least.

R = radius = one-half (½) the inside diameter of the outside course of the shell or drum.

F. S. = 5, the lowest factor of safety allowed on tanks installed after June 9, 1914.

Thickness of shell plates.

7. The minimum thickness of plates used in the construction of a tank shall be one-fourth (¼) inch.

8. The minimum thickness of shell plates shall be as follows:

When the Diameter of Shell is—			
36″ or Under	Over 36″ to 54″ Inclusive	Over 54″ to 72″ Inclusive	Over 72″
¼″	5/16″	⅜″	½″

Dished Heads for Pressure Vessels

Commonwealth of Massachusetts
Department of Public Safety
(1929 Air Tank Regulations)

Convex Head, curved outward from the Shell

12. The minimum thickness of a convex head for riveted or forge welded shells shall be:

$$t = \frac{8\frac{1}{3}\ R\ P}{S}$$

except that the least thickness shall be three-eighths inch (3/8") on tanks twenty inches (20") in diameter or larger, and five-sixteenths inch (5/16") on tanks of less than twenty inches (20") diameter.

The minimum thickness of a convex head for seamless cylinders shall be:

$$t = \frac{5\ P\ R}{S}$$

except that the least thickness shall be one-quarter inch (1/4").

Concave Head, curved inward to the Shell

The minimum thickness of a concave head shall be:

$$t_1 = 1.67\ t$$

where t = thickness, in inches, of a convex head.
P = working pressure, in pounds per square inch, for which the tank is designed.
R = radius, in inches = 1/2 the inside diameter of the outside course of the shell.
S = tensile strength of the shell plates, in pounds per square inch.
t_1 = thickness of a concave head, in inches.

Convex and concave heads shall be dished to a radius equal to or less than the diameter of the shell, and shall be true portions of spheres.

The flanging of convex and concave heads shall be carefully performed, and at the proper temperature; and if more than one heat is required, the head shall be annealed. The least radius of the flange curve shall be three (3) times the thickness of the head, and shall be measured on the concave side of head.

13. When a convex or concave head has a manhole opening, the thickness as found by the formula in paragraph 12 of this section shall be increased by not less than one eighth (1/8) inch.

14. When a convex or concave head has a manhole opening, the flange shall be turned inward, and to a depth of not less than three (3) times the thickness of the head.

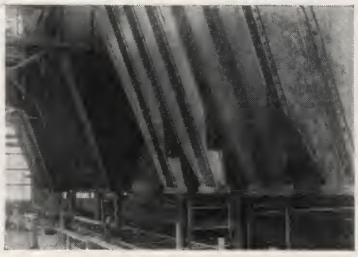
Decimals of a Foot for Inches and Fractions of an Inch

Inch	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
0	0	.0833	.1667	.2500	.3333	.4166	.5000	.5833	.6667	.7500	.8333	.9166
1/64	.0013	.0846	.1680	.2513	.3346	.4179	.5013	.5846	.6680	.7513	.8346	.9179
1/32	.0026	.0859	.1693	.2526	.3359	.4192	.5026	.5859	.6693	.7526	.8359	.9192
3/64	.0039	.0872	.1706	.2539	.3372	.4205	.5039	.5872	.6706	.7539	.8372	.9205
1/16	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9218
5/64	.0065	.0898	.1732	.2565	.3398	.4232	.5065	.5898	.6732	.7565	.8398	.9231
3/32	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9244
7/64	.0091	.0924	.1758	.2591	.3424	.4258	.5091	.5924	.6752	.7591	.8424	.9257
1/8	.0104	.0937	.1771	.2604	.3437	.4271	.5104	.5937	.6771	.7604	.8437	.9270
9/64	.0117	.0950	.1784	.2617	.3450	.4284	.5117	.5950	.6784	.7617	.8450	.9283
5/32	.0130	.0963	.1797	.2630	.3463	.4297	.5130	.5963	.6797	.7630	.8463	.9296
11/64	.0143	.0977	.1810	.2643	.3476	.4310	.5143	.5976	.6810	.7643	.8476	.9309
3/16	.0156	.0990	.1823	.2656	.3489	.4323	.5156	.5989	.6823	.7656	.8489	.9322
13/64	.0169	.1003	.1836	.2669	.3502	.4336	.5169	.6002	.6836	.7669	.8502	.9335
7/32	.0182	.1016	.1849	.2682	.3515	.4349	.5182	.6015	.6849	.7682	.8515	.9348
15/64	.0195	.1029	.1862	.2695	.3528	.4362	.5195	.6028	.6862	.7695	.8528	.9361
1/4	.0208	.1042	.1875	.2708	.3541	.4375	.5208	.6041	.6875	.7708	.8541	.9374
17/64	.0221	.1055	.1888	.2721	.3554	.4388	.5221	.6054	.6888	.7721	.8554	.9387
9/32	.0234	.1068	.1901	.2734	.3567	.4401	.5234	.6067	.6901	.7734	.8567	.9400
19/64	.0247	.1081	.1914	.2747	.3581	.4414	.5247	.6080	.6914	.7747	.8580	.9413
5/16	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6093	.6927	.7760	.8593	.9426
21/64	.0273	.1107	.1940	.2773	.3607	.4440	.5273	.6106	.6940	.7773	.8606	.9440
11/32	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6119	.6953	.7786	.8619	.9453
23/64	.0299	.1133	.1966	.2799	.3633	.4466	.5299	.6132	.6966	.7799	.8632	.9466
3/8	.0312	.1146	.1979	.2812	.3646	.4479	.5312	.6145	.6979	.7812	.8645	.9479
25/64	.0325	.1159	.1992	.2825	.3659	.4492	.5325	.6158	.6992	.7825	.8658	.9492
13/32	.0339	.1172	.2005	.2838	.3672	.4505	.5338	.6171	.7005	.7838	.8671	.9505
27/64	.0352	.1185	.2018	.2851	.3685	.4518	.5351	.6185	.7018	.7851	.8684	.9518
7/16	.0365	.1198	.2031	.2864	.3698	.4531	.5364	.6198	.7031	.7864	.8697	.9531
29/64	.0378	.1211	.2044	.2877	.3711	.4544	.5377	.6211	.7044	.7877	.8710	.9544
15/32	.0391	.1224	.2057	.2890	.3724	.4557	.5390	.6224	.7057	.7890	.8723	.9557
31/64	.0404	.1237	.2070	.2903	.3737	.4570	.5403	.6237	.7070	.7903	.8736	.9570
1/2	.0417	.1250	.2083	.2916	.3750	.4583	.5416	.6250	.7083	.7916	.8749	.9583
33/64	.0430	.1263	.2096	.2930	.3763	.4596	.5429	.6263	.7096	.7929	.8762	.9596
17/32	.0443	.1276	.2109	.2943	.3776	.4609	.5442	.6276	.7109	.7942	.8775	.9609
35/64	.0456	.1289	.2122	.2956	.3789	.4622	.5455	.6289	.7122	.7955	.8789	.9622
9/16	.0469	.1302	.2135	.2969	.3802	.4635	.5468	.6302	.7135	.7968	.8802	.9635
37/64	.0482	.1315	.2148	.2982	.3815	.4648	.5481	.6315	.7148	.7981	.8815	.9648
19/32	.0495	.1328	.2161	.2995	.3828	.4661	.5494	.6328	.7161	.7994	.8828	.9661
39/64	.0508	.1341	.2174	.3008	.3841	.4674	.5507	.6341	.7174	.8007	.8841	.9674
5/8	.0521	.1354	.2187	.3021	.3854	.4687	.5520	.6354	.7187	.8020	.8854	.9687
41/64	.0534	.1367	.2200	.3034	.3867	.4700	.5534	.6367	.7200	.8033	.8867	.9700
21/32	.0547	.1380	.2213	.3047	.3880	.4713	.5547	.6380	.7213	.8046	.8880	.9713
43/64	.0560	.1393	.2226	.3060	.3893	.4726	.5560	.6393	.7226	.8059	.8893	.9726
11/16	.0573	.1406	.2239	.3073	.3906	.4739	.5573	.6406	.7239	.8072	.8906	.9739
45/64	.0586	.1419	.2252	.3086	.3919	.4752	.5586	.6419	.7252	.8085	.8919	.9752
23/32	.0599	.1432	.2265	.3099	.3932	.4765	.5599	.6432	.7265	.8098	.8932	.9765
47/64	.0612	.1445	.2279	.3112	.3945	.4778	.6612	.6445	.7278	.8111	.8945	.9778
3/4	.0625	.1458	.2292	.3125	.3958	.4791	.5625	.6458	.7292	.8124	.8958	.9791
49/64	.0638	.1471	.2305	.3138	.3971	.4804	.5638	.6471	.7304	.8138	.8971	.9804
25/32	.0651	.1484	.2318	.3151	.3984	.4817	.5651	.6484	.7317	.8151	.8984	.9817
51/64	.0664	.1497	.2331	.3164	.3997	.4830	.5664	.6497	.7330	.8164	.8997	.9830
13/16	.0677	.1510	.2344	.3177	.4010	.4843	.5677	.6510	.7343	.8177	.9010	.9843
53/64	.0690	.1523	.2357	.3190	.4023	.4856	.5690	.6523	.7356	.8190	.9023	.9856
27/32	.0703	.1536	.2370	.3203	.4036	.4869	.5703	.6536	.7369	.8203	.9036	.9869
55/64	.0716	.1549	.2383	.3216	.4049	.4883	.5716	.6549	.7382	.8216	.9049	.9882
7/8	.0729	.1562	.2396	.3229	.4062	.4896	.5729	.6562	.7395	.8229	.9062	.9895
57/64	.0742	.1575	.2409	.3242	.4075	.4909	.5742	.6575	.7408	.8242	.9075	.9908
29/32	.0755	.1588	.2422	.3255	.4088	.4922	.5755	.6588	.7421	.8255	.9089	.9921
59/64	.0768	.1601	.2435	.3268	.4101	.4935	.5768	.6601	.7434	.8268	.9102	.9934
15/16	.0781	.1614	.2448	.3281	.4114	.4948	.5781	.6614	.7447	.8281	.9114	.9947
61/64	.0794	.1628	.2461	.3294	.4127	.4961	.5794	.6227	.7460	.8294	.9127	.9960
31/32	.0807	.1641	.2474	.3307	.4140	.4974	.5807	.6640	.7473	.8307	.9140	.9973
63/64	.0820	.1654	.2487	.3320	.4153	.4987	.5820	.6653	.7487	.8320	.9153	.9986

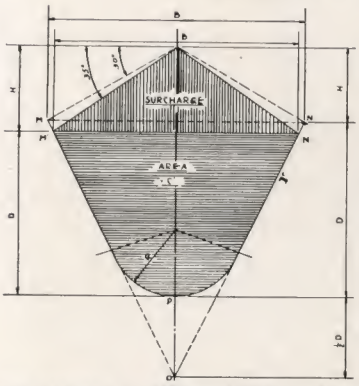
Bunkers, Hoppers and Bins

Many types of Suspended Bunkers or Bins of all kinds are used wherever various materials are stored or handled.

It is only necessary to indicate to us your general storage requirements, space needed and working conditions. Our Engineers co-operate with you in designing such structures. We will fabricate and erect anywhere and under all conditions.



Capacities of Suspension Bins



The Suspension Bunker, designed with a cross-section such that tension is the only stress produced in the envelope, is a very economical type, since stiffeners are required only on end or interior bulk-heads and on the girders which support the bag bottom.

For any given values of width B, and depth D, regardless of the weight of contained material or the ratio of B to D, a very close approximation of the correct tension curve is given by the construction shown in the accompanying diagram. Locate "O" on the center-line of the bunker at a distance $1\frac{1}{2}$D below the top, MN. Draw the lines MO and NO. Locate P on the center-line at the desired depth, D. Draw a circular arc tangent to MO and NO, and passing through P. The outline MPN is close enough to the ideal tension-curve for detailed design as well as for estimating.

The capacity below the line MN, in cubic feet per foot of length is

$$C = \tfrac{5}{8}\,BD$$

Capacity per foot of length in tons of coal at 50 pounds per cubic foot is

$$T = \frac{BD}{64}$$

For bunkers carrying a surcharge, use 30° slopes from M and N to determine maximum loading height "H" so as to prevent over-flow, and use 35° slopes from the peak so located, to calculate storage capacity, which will be

$C' = \tfrac{5}{8}\,B'D' +$ surcharge volume, or $T' = \dfrac{B'D'}{64} +$ surcharge tonnage.

In figuring the surcharge, loss due to end slopes and to cross-valleys between load points must be considered.

Stacks

Our long experience in the design and manufacture of Stacks of all kinds, enables us to properly fabricate and erect any type or size, either self-supporting or guyed construction.

When sending inquiries for Stacks, all the information possible to secure should be furnished, such as horse-power of boilers, flue sizes or openings in boilers, height and style of foundation, wind loads if unusual and all local information available.

Our Engineering Department is at your disposal.

Guyed Steel Stacks

Recommended Thicknesses:

Diameter	Maximum	Minimum
30″	No. 8 Ga.	No. 10 Ga.
36″	3/16″	No. 10 Ga.
42″	1/4″	No. 10 Ga.
48″	1/4″	No. 8 Ga.
54″	5/16″	3/16″
60″	5/16″	3/16″

1/16″ is often added to above thicknesses for corrosion.

Guys:

Stacks up to 60′ or 70′ high, usually require
1—set 4-way guys.
Stacks over 70′ high, usually require
2—sets 4-way guys.
Stacks over 125′ high, usually require
3—sets 4-way guys.

A single set of guys is usually attached to stack about 1/3 way down from top. When 2 sets of guys are used, it is usual practice to locate first set about 2/3 height of stack and the second set about 4/9 height of stack. When 3 sets of guys are used, the first set is placed at H − 12 ft. and the second set at 3/4 H − 12 ft. and the third set at 1/2 H − 12 ft. In this case H is the height in feet of Stack.

Self-Supporting Steel Stacks

Diameter of Cone Bottom usually 1/3 larger in diameter than straight stack section.

Height of Cone should be approximately 1/4 entire height of Stack.

The Conical Section of a well-designed Self-Supporting Stack should be made so that the apex of the cone would be at the top of the Stack.

See table on following page for recommended specifications on Self-Supporting Stacks.

Self-Supporting Steel Stacks

Diam.	Height	Horse-Power	Anchor Bolts		Bottom Section Including Flare		2nd Section		3rd Section		4th Section		5th Section		6th Section		7th Section		Flare Straight Conical		Total Weight
			Number	Diam.	Height	Plates	Height	Plates	Height	Plates	Height	Plates	Height	Plates	Height	Plates	Height	Plates	Diam. Base	Height	
Ft.	Ft.			In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft., In.	Ft.	Lb.
4	100	348	16	1 3/8	45	5/16	15	1/4	40	3/16									5–9	30	20,000
5	125	632	14	1 7/8	45	3/8	15	5/16	20	1/4	45	3/16							6–7	30	32,800
6	125	934	24	1 3/8	40	5/16	15	5/16	20	1/4	50	3/16							8–10	40	35,690
7	150	1,418	18	1 7/8	55	3/8	20	5/16	20	1/4	55	3/16							9–7	40	55,740
8	175	2,027	20	2 1/8	55	7/16	20	3/8	20	5/16	20	1/4	60	3/16					10–4	40	80,950
9	200	2,771	24	2 1/8	75	7/16	20	3/8	20	5/16	25	1/4	60	3/16					12–5	55	108,900
10	200	3,448	26	2 1/8	70	7/16	20	3/8	20	5/16	25	1/4	65	3/16					13–3	50	119,000
10	250	3,855	26	2 3/4	80	7/16	20	1/2	20	7/16	20	3/8	20	5/16	25	1/4	65	3/16	13–4	55	187,400
12	225	5,330	32	2 1/8	80	7/16	20	3/8	25	5/16	100	1/4							16–4	60	165,000
12	250	5,618	30	2 1/2	85	1/2	20	7/16	20	3/8	25	5/16	100	1/4					16–3	65	206,800
14	225	7,310	40	1 7/8	90	3/8	25	5/16	110	1/4									19–8	65	173,400
14	275	8,110	36	2 1/2	75	1/2	20	1/2	20	7/16	25	3/8	25	5/16	110	1/4			19–3	75	265,600
15	225	8,440	42	1 7/8	85	3/8	140	5/16											20–6	60	197,300
15	275	9,340	36	2 1/4	85	1/2	25	7/16	25	3/8	140	5/16							19–8	65	288,500
16	250	10,138	42	2 1/8	55	7/16	30	7/16	25	3/8	145	5/16							20–6	55	250,300
16	300	11,105	38	2 3/4	60	9/16	20	9/16	25	1/2	25	7/16	25	3/8	145	5/16			20–0	60	357,500
18	250	12,894	50	1 7/8	70	3/8	30	3/8	150	5/16									25–0	70	262,800
18	300	14,123	44	2 1/2	70	1/2	25	1/2	25	7/16	30	3/8	150	5/16					23–6	70	375,300
20	250	15,980	54	1 7/8	60	3/8	190	3/8											26–4	60	323,700
20	300	17,505	48	2 1/2	60	1/2	25	1/2	25	7/16	190	3/8							25–0	60	442,600

Stainless Steel

Heat and Corrosion-Resistant Alloy Tank Construction

First unit of a number of Nitric Acid Absorption Towers 8 ft. by 43 ft., used in making nitric acid from ammonia. High Chrome Alloy throughout, including fittings.
Equipment for this plant fabricated and erected by Lancaster Iron Works.

Chrome Alloy fabrication of Pressure Vessels, Stills, Retorts, Columns, Vats, Acid Storage Tanks, etc., is a Lancaster specialty.

The demands of the process industries for high grade equipment to resist corrosion and frequently to operate under high temperatures and high pressure or vacuum, are well known in the Lancaster organization. We have in our shops, skilled workmen, trained to fabricate equipment made of various chromium and other alloys and we can reduce your ultimate cost of equipment and operating difficulties from Heat, Pressure and Corrosion by combining our fabricating experience with your own general design.

The terms "Stainless Steel" and "Rustless Steel" are in many cases misnomers and should be better termed "Corrosion and Rust Resistant."

The Iron-Carbon-Chromium-Stainless Steel made its first appearance through the cutlery industry and under the ordinary usages of that service, the material is both rustless and stainless, but not under ***all*** conditions.

"Stainless Steel" as first made in the United States was known only in the following type analysis:

Carbon	.30%
Chromium	13.00%
Iron	Balance

Its use was limited largely to cutlery. Since that time many investigators have been at work on the corrosion-resisting steels and we have on hand today many modifications of the original analysis.

To obtain an understanding of the fundamental principles governing corrosion-resisting steels, it should first be thoroughly understood that iron is soluble in water and, secondly, that iron combined with carbon is not only soluble in

Stainless Steel—*Continued*

water and, therefore, rusts like iron, but that the corrosion is much more rapid, due to the galvanic action between the iron itself and the carbides of iron. This creates selective corrosion and pitting. For this reason iron of the purest varieties, under corrosive conditions, has always withstood such corrosive action better than steel.

To obtain a corrosive-resistant iron, therefore, it is necessary to introduce some alloy, or alloys, to iron which will first render it insoluble, and then, if there be carbides present, prevent, if possible, galvanic action from setting up selective corrosion or pitting.

Brearley apparently covered in his patent the range of chromium between 9 and 16 per cent, knowing that heat treatment was essential to produce homogeneity, and realizing that over 16 per cent chromium additions rendered the material immune to heat treatment in the sense of hardening. Since that time, however, the higher chromium alloys have been further developed and, even where free carbides exist, the material is found to be extremely resistant to corrosive attack.

With the knowledge, therefore, that certain percentages of chromium in combination with iron render the resultant iron-chromium insoluble in water and many other solutions, and that the carbides present in such alloys, with less than 16 per cent chromium, can be diffused throughout the mass (i.e., dissolved into the iron-chromium matrix) by heat treatment, it is seen that a material can be produced which is insoluble in water, and which possesses that homogeneity which removes the possibility of galvanic action. Such a material, therefore, could be termed a corrosion-resistant alloy.

The effect of carbon: In a high-chromium corrosion-resisting steel, the carbon is present in the form of a chromium carbide. This carbide contains 94.5% by weight of chromium and 5.5% by weight of carbon. It will thus be seen that each point of carbon takes to itself about seventeen points of chromium. For example, a high-chromium steel containing .10% carbon uses up 1.70% chromium, while a .30% carbon steel uses about 5.00% of chromium in the form of carbide.

When these high-chromium steels are in the annealed condition, the chromium which is held as carbide is not useful for resisting corrosion. When the same steels are hardened, however, and the carbide is in solution, all of the chromium then becomes available for resisting corrosion. This point is mentioned in order to explain why, in a steel of any given chromium content, the resistance to corrosion increases as the percentage of carbon decreases. It also explains one reason why hardening increases the stainless properties of these alloys and further explains why the high-carbon "Stainless Steels" stand in greater need of hardening than the low-carbon "Stainless Irons."

The effect of chromium: The second point to be emphasized is even more important and is less generally understood. If we make up a series of low-carbon iron-chromium alloys (all of which contain .10% carbon) in which the chromium varies from zero at one end of the series up to 30.00% at the other end of the series, and then test the chemical and physical properties of each steel, we make one very striking observation.

As the percentage of chromium reaches approximately 15.00%, the entire physical characteristics of the alloys change; the steels containing less than

Stainless Steel—*Continued*

14.00% chromium are entirely unrelated to those containing more than 16.00% chromium. (The range between 14.00% and 16.00% chromium is a sort of transition zone and partakes of the properties of both groups.) It is absolutely necessary for a prospective user of low-carbon chromium steels to understand this division into two groups, because alloys containing less than 14.00% chromium are suitable for entirely different uses from those containing more than 16.00% chromium.

There is only one property which is practically continuous as the chromium increases, and that is the resistance to corrosion. It may be truthfully said that, other things being equal, the higher the chromium the greater the resistance to heat and corrosion. This property is continuous throughout the entire series up to 30.00% chromium.

* * *

Some of the important features of chromium alloys may be summarized as follows:

1. The higher the carbon, the lower the corrosion-resistance.

2. The higher the chromium, the better the corrosion-resistance.

3. Chromium-irons containing less than 15.00% chromium are entirely different physically from those containing more than 15.00% chromium.

The Lower Chromium Alloys:

Can be heat-treated to show remarkable tensile properties.

Are not subject to notch brittleness—are extremely tough.

Are not subject to excessive grain-growth at high temperatures.

Will air-harden after forging, welding or riveting.

Are very ductile both hot and cold.

Machine readily.

Possess good corrosion-resisting properties.

Can be economically fabricated.

The Higher Chromium Alloys:

Do not respond to heat-treatment.

Are extremely brittle in sharp-notched sections.

Are liable to excessive grain-growth at high temperatures.

Do not air-harden after forging, welding or riveting.

Are moderately ductile both hot and cold.

Machine satisfactorily.

Possess super corrosion-resisting properties.

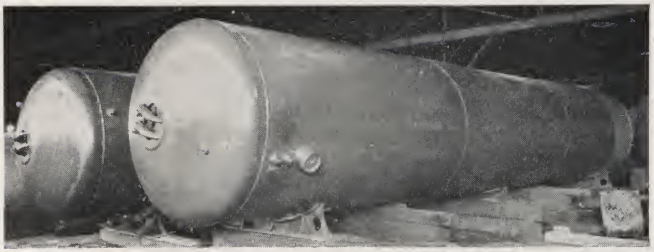
Are somewhat more expensive to fabricate.

4. Corrosion tests conducted under commercial conditions are much more dependable than laboratory tests.

5. Non-tarnishable surfaces are possible only when the scale is *entirely* removed. The scale need not be removed where appearance is not a vital factor.

6. Corrosive attack is considerably influenced by galvanic effects produced by contact with other metals.

Welding—Gas and Electric



Gas Welded Pressure Vessels 7′ dia. x 38′ long manufactured under Procedure Control. These vessels are tested to three times the Working Pressure to insure absolute tightness under severe operating conditions.

While Welding is not yet an exact science, still an unusual amount of Welded Steel Construction has been put into use in the past few years with extremely good results. The practical uses to which Welding has been applied and the recent extensive experiments in the Welding Field, have brought about better methods of Shop and Field Welding. The results have been in many cases even more satisfactory than for Riveted Work and have popularized Welding in all fields.

The Lancaster Iron Works has kept pace with the advancement and manufactures Welded Storage and Pressure Vessels as well as Piping and general Steel Plate Construction.

We cannot, however, guarantee any Welded Work if improperly designed, any more than we could guarantee improperly designed Riveted Work. The same problems of design are encountered with Welded Joints as with other types.

Assuming that the design is correct and the proper procedure is followed in manufacture, there can be no doubt about the tensile strength of either the weld metal, or the base metal, because these can easily be determined by tensile test. This has been done numberless times and it has been found that the tensile strength runs from 45,000 pounds to 75,000 pounds per square inch, depending upon the welding rod and process used.

Our engineers will be glad to assist with problems of design and our shops are excellently equipped to handle any ordinary kind of electric-arc or oxy-acetylene welding.

Sulphuric Acid Storage Tanks—Vertical Type

Building Acid Storage Tanks is quite another thing from the fabrication of ordinary Steel Plate Work. Only the most experienced shop and field workmen can be used. In our organization are men who have specialized on Acid-Plant construction and we are well able to take care of any requirements for such work.

Absorption and Scrubber Towers 7½ ft. x 31½ ft.
At extreme right 50 ft. diameter Acid Storage Tank.

Principal Uses of Sulphuric Acid

For decomposing salts with the production of nitric acid, hydrochloric acid and sodium sulphate, thus indirectly in manufacturing soda ash, soap, glass, etc.

For the purification of oils—petroleum, tar oils, etc.

For pickling iron articles previous to tinning or galvanizing.

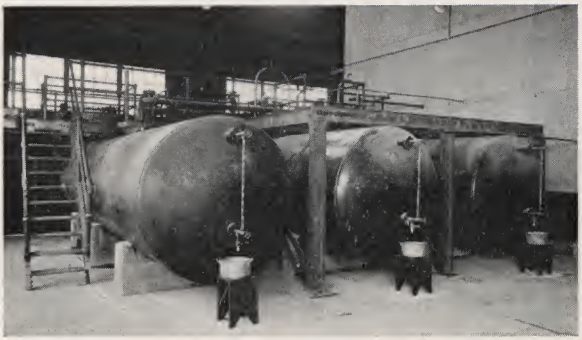
As a drying agent in the production of organic dyes, on which the textile industry depends.

For rendering soluble mineral and animal phosphate for manures for agriculture.

For the manufacture of nitric acid from saltpetre.

Sulphuric acid forms the starting point of or is used in almost every important industry.

Degrees Baumé	Specific Gravity	Per Cent H_2SO_4	Weight of 1 Cu. Ft. Pounds	Gallons Per Ton	Cu. Feet Per Ton	Weight Per Gal. Pounds
50	1.5263	62.18	95.20	157.1955	21.0084	12.723
55	1.6111	69.65	100.48	148.9203	19.9044	13.430
60	1.7059	77.67	106.40	140.6469	18.7969	14.220
66	1.8354	93.19	114.47	130.7189	17.4718	15.300

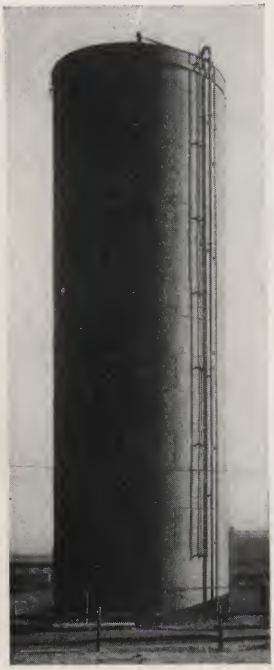


6′ dia. x 26′ Circulating Tanks for Contact Acid Plant—All Acid Tanks and Piping furnished by Lancaster Iron Works

Sulphuric Acid Storage Tanks—Horizontal Type

Dia. of Tank	Capacity in Tons Per Foot of Length	Degrees Baumé	Specific Gravity	Per Cent H_2SO_4
4′	.597981	50	1.5263	62.18
4′	.631210	55	1.6111	69.65
4′	.668340	60	1.7059	77.67
4′	.719100	66	1.8354	93.19
5′	.934771	50	1.5263	62.18
5′	.986299	55	1.6111	69.65
5′	1.044316	60	1.7059	77.67
5′	1.123632	66	1.8354	93.19
6′	1.395521	50	1.5263	62.18
6′	1.420289	55	1.6111	69.65
6′	1.503836	60	1.7059	77.67
6′	1.618128	66	1.8354	93.19
7′	1.831348	50	1.5263	62.18
7′	1.933064	55	1.6111	69.65
7′	2.046826	60	1.7059	77.67
7′	2.202282	66	1.8354	93.19
8′	2.39198	50	1.5263	62.18
8′	2.52490	55	1.6111	69.65
8′	2.67343	60	1.7059	77.67
8′	2.87647	66	1.8354	93.19
9′	3.02737	50	1.5263	62.18
9′	3.19560	55	1.6111	69.65
9′	3.38357	60	1.7059	77.67
9′	3.64055	66	1.8354	93.19
10′	3.73750	50	1.5263	62.18
10′	3.94519	55	1.6111	69.65
10′	4.17772	60	1.7059	77.67
10′	4.49452	66	1.8354	93.19

Water Standpipes



Standpipe 30′ dia. x 95′ high

When a City, a Village or an Industrial Plant buys a Standpipe, they don't want to worry about the proper design or how it should be fabricated. Our long experience enables us to satisfy the most exacting demands and specifications. We erect with our own crews and equipment and can furnish Standpipes of Iron or Steel Construction, or of Copper-bearing Steel, if desired.

STANDPIPES should be Correctly Designed, Carefully Built and Properly Erected

Lancaster Standard
1,000,000 gallon Standpipe
can be furnished in varying diameters and heights.

Over twenty of these standard Standpipes have been built and erected by us throughout Pennsylvania, Maryland, North Carolina, New Jersey, New York, Massachusetts and elsewhere.

Standpipe 54′ dia. x 60′ high

Refinery Construction

Photograph of Vaporizer—10′ dia. x 43′ long constructed of 1¼″ steel plate throughout designed and built for 200 pounds pressure. Weight of Vaporizer 90,000 pounds.

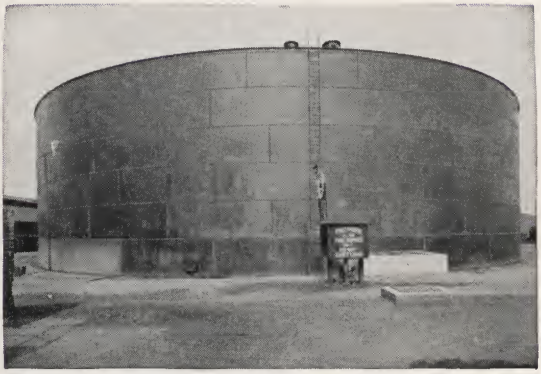
In the construction of difficult and heavy Refinery Equipment, our two large steel fabricating plants are able to take care of almost any kind of work.

Stills, Agitators, Condenser Boxes, Absorbers, Fractionators, Rundown Tanks and Storage Tanks of any size, can be built to standard or individual specifications.

Our Engineering Department and Plant Facilities are at your service.

Shipping Large Fractionators for a Mid-West Refinery

Standard Specifications
LANCASTER
Field Storage Tanks



Lancaster is especially equipped to design, manufacture and erect Field Storage Tanks for practically every storage purpose. The standard sizes range in

Capacities from 1,000 to 80,000 Barrels

SPECIAL TANKS of any size are designed, fabricated and erected to meet special storage conditions and specifications. In special work, give the following information: Use; Capacity; Height; Erection conditions at proposed site; Distance from nearest railroad siding.

Lancaster Engineers will be glad to assist you with any problems you may have pertaining to Field Storage Tanks of large capacity or unusual storage or construction conditions.

Table of Specifications of Lancaster Standard Field Storage Tanks

NOMINAL CAPACITY In Barrels. 42 U.S. Gals.	DIAMETERS In Feet and Inches	HEIGHTS In Feet and Inches.	RING 1			RING 2			RING 3			RING 4			RING 5			RING 6			RING 7			BOTTOM			TOP CURB ANGLE Inches	APPROX. SHIPPING WEIGHTS Pounds
			Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	Plate Thickness Inches	Vertical Joints	Rivet Diameters Inches	BOTTOM CURB ANGLE Inches	Plates Rectangular	Plates Sketch		
1,000	20–0	18–0	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2															2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	20,100
1,500	25–0	18–0	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2															2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	26,800
2,000	25–0	24–0	1/4	L2	5/16	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2												2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	32,600
2,200	30–0	18–0	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2															2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	34,300
3,000	30–0	24–0	1/4	L2	5/16	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2												2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	41,500
5,000	35–0	30–0	1/4	L2	5/16	1/4	L2	5/16	3/8	L2	5/16	3/8	L2	1/2	3/8	L1	1/2									2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	57,400
7,000	40–0	30–0	1/4	L2	5/16	1/4	L2	5/16	3/8	L2	5/16	3/8	L2	1/2	3/8	L1	1/2									2 1/2x2 1/2x 3/8	3/8	3/8	2 1/2x2 1/2x 1/4	68,800
10,000	50–0	30–0	5/16	L2	5/16	1/4	L2	5/16	3/8	L2	5/16	3/8	L2	1/2	3/8	L1	1/2									3 x3 x 3/8	3/8	1/4	2 1/2x2 1/2x 1/4	94,100
15,000	60–0	30–0	5/16	L2	5/16	1/4	L2	5/16	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2									3 x3 x 3/8	3/8	1/4	2 1/2x2 1/2x 1/4	128,800
20,000	70–0	30–0	5/16	L2	5/16	1/4	L2	5/16	1/4	L2	5/16	3/8	L2	1/2	3/8	L1	1/2									3 x3 x 3/8	3/8	1/4	2 1/2x2 1/2x 1/4	159,200
25,000	80–0	30–0	3/8	L3	7/16	5/16	L2	3/8	1/4	L2	5/16	1/4	L2	5/16	3/8	L1	1/2									3 x3 x 3/8	3/8	1/4	2 1/2x2 1/2x 1/4	213,800
30,000	85–0	30–0	3/8	L3	7/16	5/16	L2	3/8	5/16	L2	3/8	1/4	L2	5/16	3/8	L1	1/2									3 x3 x 3/8	3/8	1/4	2 1/2x2 1/2x 1/4	236,000
37,500	95–0	30–0	7/16	L3	1/2	3/8	L3	7/16	5/16	L2	3/8	1/4	L2	5/16	3/8	L1	1/2									4 x4 x 1/2	3/8	1/4	2 1/2x2 1/2x 1/4	293,200
55,000	115–0	30–0	1/2	L3	1/2	7/16	L3	1/2	3/8	L3	7/16	1/4	L2	5/16	3/8	L1	1/2									4 x4 x 1/2	3/8	1/4	2 1/2x2 1/2x 1/4	410,900
64,000	115–0	34–8	17/32	B4	1/2	1/2	B3	7/16	7/16	L3	7/16	5/16	L2	5/16	1/4	L2	5/16	1/4	L1	1/2						4 x4 x 1/2	3/8	1/4	3 x3 x 3/8	481,800
74,000	115–0	40–0	1/2	B4	1	1/2	B4	7/16	1/2	L4	7/16	7/16	L3	1/2	5/16	L3	3/8	1/4	L2	5/16	1/4	L1	1/2			4 x4 x 5/8	3/8	1/4	3 x3 x 3/8	549,100
80,000	117–2 1/2	41–10	1/2	B4	1	17/32	B4	7/16	1/2	L4	7/16	7/16	L3	1/2	5/16	L3	3/8	1/4	L2	5/16	1/4	L1	1/2			4 x4 x 5/8	3/8	1/4	3 x3 x 3/8	583,100

NOTE:—L1–Indicates Single Riveted Lap, L2–Double Riveted Lap, etc. B3–Indicates Triple Riveted Double Butt, B4–Quadruple Riveted Double Butt

American Petroleum Institute Standard Vertical Storage Tanks

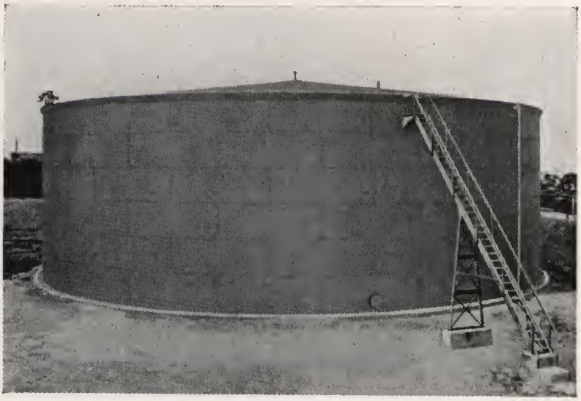
Tables shown on this page and following page cover A. P. I. Specifications (revised Sept. 1929) for materials and various styles of riveted joints, together with sizes and capacities.

Any of these tanks can be fabricated and erected by us promptly in addition to our standard tanks shown on pages 78 and 82.

Diameter of Tanks	Capacity in Barrels	Height	Courses																										Bottom		Roof		Approximate Shipping Weight
			First			Second			Third			Fourth			Fifth			Sixth			Seventh			Eighth						Bottom Curb Angle in Inches	Plates	Roof Curb Angle in Inches	Plates	
			Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.					
36 Ft.	5,300	29'- 6"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"	7.65#	L1	7/8"													3x3x5/16	10.2#	2½x2½x5/16	3/8"	55,720#
	6,400	35'- 4"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"	7.65#	L1	7/8"										3x3x5/16	10.2#	2½x2½x5/16	3/8"	63,195#
	7,400	41'- 1"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"	7.65#	L1	7/8"							3x3x5/16	10.2#	2½x2½x5/16	3/8"	72,585#
	8,400	46'-11"	12.75#	L2	5/8"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"	7.65#	L1	7/8"				3x3x5/16	10.2#	2½x2½x5/16	3/8"	82,210#
48 Ft.	9,500	29'- 5"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"													3x3x5/16	10.2#	2½x2½x5/16	3/8"	87,225#
	11,300	35'- 3"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"										3x3x5/16	10.2#	2½x2½x5/16	3/8"	99,520#
	13,200	41'- 0"	14.03#	L3	3/4"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"							3x3x5/16	10.2#	2½x2½x5/16	3/8"	113,220#
	15,000	46'-10"	15.3#	L3	3/4"	14.03#	L3	5/8"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	7.65#	L1	7/8"	7.65#	L1	7/8"				3x3x5/16	10.2#	2½x2½x5/16	3/8"	128,540#
60 Ft.	15,000	29'- 3"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	10.2#	L1	5/8"													3x3x5/16	10 2# 12 75#	2½x2½x5/16	3/8"	135,545#
	17,500	35'- 1"	14.03#	L3	5/8"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	10.2#	L1	5/8"										3x3x5/16	10 2# 12 75#	2½x2½x5/16	3/8"	153,480#
	20,500	40'-10"	16.58#	L3	3/4"	14.03#	L3	5/8"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	10.2#	L1	5/8"							3x3x5/16	10 2# 12 75#	2½x2½x5/16	3/8"	175,005#
	23,500	46'- 7"	19.13#	L3	3/4"	16.58#	L3	3/4"	14.03#	L3	5/8"	12.75#	L2	5/8"	10.2#	L2	5/8"	10.2#	L2	5/8"	10.2#	L1	5/8"	10.2#	L1	5/8"				3x3x5/16	10 2# 12 75#	2½x2½x5/16	3/8"	201,110#

Diameter of Tanks	Capacity in Barrels	Height	Courses																								Bottom		Roof		Approximate Shipping Weight
			First			Second			Third			Fourth			Fifth			Sixth			Seventh			Eighth			Bottom Curb Angle in Inches	Bottom Plates	Roof Curb Angle in Inches	Roof Plates	
			Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.	Plate Thickness	Vert. J'nts	Rivet Dia.					
78 Ft.	25,000	29'- 4"	15.3#	L3	¾"	12.75#	L2	⅝"	10.2#	L2	⅝"	10 2#	L1	⅝"	10.2#	L1	⅝"											4x4x½	10 2# 12 75#	3 x3 x⅜	⅜"	214,330#
	30,000	35'- 1"	17 85#	L3	¾"	15.3#	L3	¾"	12.75#	L2	⅝"	10 2#	L2	⅝"	10 2#	L2	⅝"	10.2#	L1	⅝"								4x4x½	10 2# 12 75#	3 x3 x⅜	½"	243,325#
	35,000	40'-10"	19 13#	L3	¾"	17 85#	L3	¾"	15 3#	L3	¾"	12 75#	L2	⅝"	10 2#	L2	⅝"	10 2#	L1	⅝"	10 2#	L1	⅝"					4x4x½	10 2# 12 75#	3 x3 x⅜	½"	276,215#
	39,500	46'- 7"	20 4#	B4	⅞"	19 13#	L3	¾"	17 85#	L3	¾"	15.3#	L3	¾"	12.75#	L2	⅝"	10 2#	L2	⅝"	10.2#	L1	⅝"	10 2#	L1	⅝"		4x4x½	10 2# 12 75#	3 x3 x⅜	⅜"	313,845#
102 Ft.	42,500	29'- 3"	19.13#	L4	¾"	16 58#	L3	¾"	12.75#	L2	⅝"	10 2#	L2	⅝"	10.2#	L1	⅝"											4x4x⅝	10 2# 12 75#	3 x3 x⅜	⅜"	350,595#
	51,000	35'- 0"	20 4#	B4	⅞"	19 13#	L4	¾"	16.58#	L3	¾"	12 75#	L2	⅝"	10 2#	L2	⅝"	10 2#	L1	⅝"								4x4x⅝	10 2# 12 75#	3 x3 x⅜	⅜"	398,435#
	59,000	40'- 8"	22.96#	B4	1"	20.4#	B4	1"	19 13#	L4	¾"	16 58#	L3	¾"	12.75#	L2	⅝"	10.2#	L2	⅝"	10 2#	L1	⅝"					4x4x⅝	10 2# 12 75#	3 x3 x⅜	½"	452,005#
	68,000	46'- 5"	25.5#	B4	1"	22.96#	B4	1"	20 4#	B4	1"	19.13#	L4	¾"	16.58#	L3	¾"	12.75#	L2	⅝"	10.2#	L2	⅝"	10 2#	L1	⅝"		4x4x⅝	10 2# 12 75#	3 x3 x⅜	½"	516,630#
120 Ft.	59,000	29'- 3"	19.13#	B4	¾"	17.85#	L4	¾"	14 03#	L3	⅝"	10 2#	L2	⅝"	10.2#	L1	⅝"											4x4x⅝	10 2# 12 75#	3 x3 x⅜	⅜"	461,135#
	70,000	35'- 0"	22.95#	B4	1"	19.13#	B4	¾"	17.85#	L4	¾"	14 03#	L3	⅝"	10.2#	L2	⅝"	10 2#	L1	⅝"								4x4x⅝	10 2# 12 75#	3 x3 x⅜	⅜"	523,575#
	82,000	40'- 8"	25.50#	B5	1"	22.95#	B4	1"	19 13#	B4	¾"	17 85#	L4	¾"	14 03#	L3	⅝"	10 2#	L2	⅝"	10.2#	L1	⅝"					4x4x⅝	10 2# 12 75#	3 x3 x⅜	½"	594,330#
	93,000	46'- 5"	30.6#	B4	1"	25.50#	B5	1"	22.95#	B4	1"	19 13#	B4	¾"	17.85#	L4	¾"	14.03#	L3	⅝"	10 2#	L2	⅝"	10.2#	L1	⅝"		4x4x⅝	10 2# 12 75#	3 x3 x⅜	½"	682,965#
144 Ft.	85,000	29'- 2"	22.95#	B4	1"	19 13#	B3	¾"	16.58#	L3	¾"	12.75#	L2	⅝"	10.2#	L1	⅝"											4x4x⅜	10 2# 12 75#	3 x3 x⅜	½"	661,890#
	101,000	34'-10"	28 05#	B4	1"	22.95#	B4	1"	19.13#	B3	¾"	16.58#	L3	¾"	12.75#	L2	⅝"	10.2#	L1	⅝"								4x4x⅜	10 2# 12 75#	3 x3 x⅜	½"	753,250#
	118,000	40'- 6"	31.90#	B4	1⅛"	28.05#	B4	1"	22.95#	B4	1"	19.13#	B3	¾"	16 58#	L3	¾"	12 75#	L2	⅝"	10 2#	L1	⅝"					4x4x⅜	10 2# 12 75#	3 x3 x⅜	½"	860,575#
	134,000	46'- 2"	35.70#	B5	1⅛"	31.90#	B4	1⅛"	28.05#	B4	1"	22.95#	B4	⅞"	19.13#	B3	¾"	16.58#	L3	¾"	12.75#	L2	½"	10.2#	L1	⅝"		4x4x⅜	10 2# 12 75#	3 x3 x⅜	½"	986,410#

Standard Specifications
LANCASTER
Molasses Storage Tanks



Standard Sizes 100,000 to 2,000,000 Gallons

Molasses Storage Tanks are necessarily designed and built of heavier materials, with higher efficiency joints than ordinarily used in Storage Tanks.

They must be properly vented and constructed with every possible safety feature embodied to minimize danger from explosion.

Our experience in building and erecting Molasses Storage or other kinds of Syrup Storage Tanks for the large sugar companies enables us to take care of your requirements with speed and satisfaction.

See Table of Specifications on opposite page.

Table of Specifications of Lancaster Standard Molasses Storage Tanks

NOMINAL CAPACITY In U. S. Gallons	DIAMETERS	HEIGHTS	RING 1			RING 2			RING 3			RING 4			RING 5			BOTTOM		TOP CURB ANGLE	APPROX. SHIPPING WEIGHTS WITH ROOF	APPROX. SHIPPING WEIGHTS WITHOUT ROOF (Open Top)
			Plate Thickness	Vertical Joints	Rivet Diameters	Plate Thickness	Vertical Joints	Rivet Diameters	Plate Thickness	Vertical Joints	Rivet Diameters	Plate Thickness	Vertical Joints	Rivet Diameters	Plate Thickness	Vertical Joints	Rivet Diameters	BOTTOM CURB ANGLE	Plate Thickness			
100,000	27'-0"	25'-0"	1/4"	L2	5/8"	1/4"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"				3" x 3" x 3/8"	1/4"	3" x 3" x 1/4"	43,362 lb.	35,275 lb.
150,000	31'-0"	27'-0"	1/4"	L2	5/8"	1/4"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"				3" x 3" x 3/8"	1/4"	3" x 3" x 3/8"	51,842 lb.	43,845 lb.
200,000	36'-0"	27'-0"	5/16"	L2	5/8"	1/4"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"				3" x 3" x 3/8"	1/4"	3" x 3" x 3/8"	70,763 lb.	56,981 lb.
250,000	40'-0"	27'-0"	3/8"	L2	5/8"	1/4"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"				3" x 3" x 3/8"	1/4"	3" x 3" x 3/8"	78,385 lb.	61,446 lb.
300,000	44'-0"	27'-0"	11/16"	L2	5/8"	5/16"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"				3" x 3" x 3/8"	1/4"	3" x 3" x 3/8"	90,342 lb.	69,533 lb.
500,000	54'-3"	29'-0"	7/16"	L3	3/4"	11/16"	L2	5/8"	11/16"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"	3 1/2" x 3 1/2" x 3/8"	1/4"	3" x 3" x 3/8"	137,173 lb.	106,339 lb.
750,000	67'-0"	29'-0"	1/2"	L4	3/4"	7/16"	L3	3/4"	11/16"	L2	5/8"	1/4"	L2	5/8"	1/4"	L1	5/8"	4" x 4" x 1/2"	1/4"	3" x 3" x 3/8"	197,666 lb.	154,902 lb.
1,000,000	78'-0"	29'-3"	13/16"	L4	7/8"	1/2"	L3	7/8"	3/8"	L3	3/4"	11/16"	L2	5/8"	1/4"	L1	5/8"	4" x 4" x 1/2"	1/4"	3" x 3" x 3/8"	262,630 lb.	205,013 lb.
1,500,000	94'-0"	29'-3"	11/16"	B3	7/8"	9/16"	L4	7/8"	11/16"	L3	3/4"	5/8"	L2	5/8"	1/4"	L1	5/8"	4" x 4" x 5/8"	1/4"	3" x 3" x 3/8"	361,609 lb.	285,186 lb.
2,000,000	108'-0"	30'-0"	3/4"	B4	1"	5/8"	L4	7/8"	11/16"	L3	7/8"	3/8"	L2	3/4"	1/4"	L1	5/8"	6" x 6" x 5/8"	1/4"	3" x 3" x 3/8"	503,427 lb.	403,173 lb.

NOTE:—L1–Indicates Single Riveted Lap, L2–Double Riveted Lap, etc. B3–Indicates Triple Riveted Double Butt, B4–Quadruple Riveted Double Butt

Dredge Pipe

Riveted or Welded Shore and Pontoon Pipe

Lancaster Dredge Pipe is known throughout the United States, wherever suction dredge work is being carried on.

We have been pioneers in the design and development of modern dredge pipe and construct many miles of pipe annually.

Any style pipe can be supplied 12″ dia. and upwards, made of our Special Analysis Pipe Steel containing a high percentage of carbon and manganese.

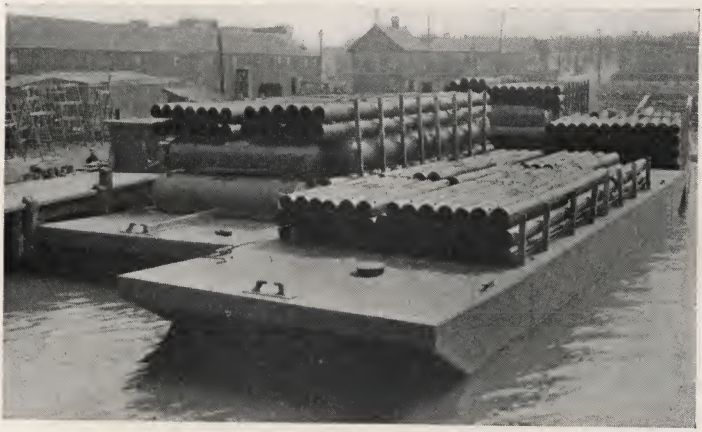
Shore Pipe constructed with our special Posey Joints fits easily and will last longer.

PONTOON CYLINDERS—CATAMARANS
GATE VALVES—WYE-BRANCHES
COMBINATION "WYE-VALVES"
STEEL BARGES AND DREDGE HULLS

Dredge Pipe Wye Branch—Side Outlet Type

Barges and Dredges

Dredge Hulls, Car Floats, Gold, Tin and Platinum Dredges, complete with Superstructure, Ladders, Housing, etc., built in our shops and erected anywhere.



Part of a fleet of all-steel Barges 25′ x 85′ x 7′, designed and fabricated in our shops and erected and launched in our yards along the Chesapeake Bay. These Barges were towed to Miami, Florida, loaded with Lancaster Dredge Pipe and Pontoons.

MONITOR STEEL BOILERS

For Steam, Vapor and Hot Water Heating Constructed for Burning

Coal, Gas or Oil as Fuel

The Monitor Bi-Loop Radiator Company has recently been absorbed by the Lancaster Iron Works, Inc., and the well-known Monitor "U" Tube Boilers, on the market and used successfully since 1888, are now being manufactured and distributed from our plant in Lancaster, Pa.

Monitor Steel Boilers have stood the test of time. Thousands of Monitor Boiler installations are still giving good service, many of them after more than thirty years usage under severe conditions.

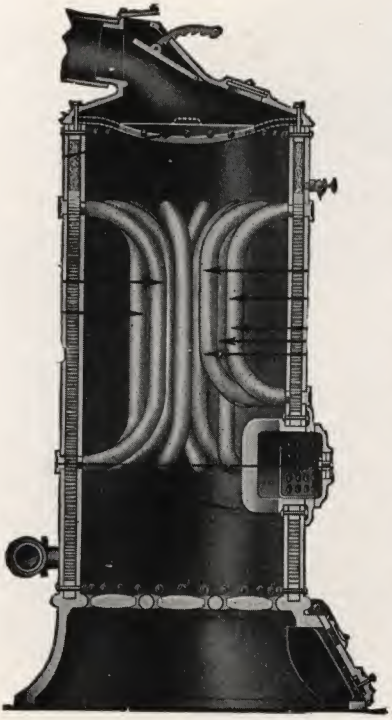
Adaptability to Oil Burning. The Monitor Boiler is ideally designed for the burning of oil. The steel shell and tubes will stand the sudden flash of a hot flame and each "U" shaped Tube, being a separate circulating medium and in direct contact with the flame of an oil burner assure rapid circulation and quick steaming. The base of the Monitor Boiler is so constructed that the installation of an oil burner can be made with little effort.

"The U-Tube does it"

In continuing the manufacture and distribution of Monitor "U" Tube Boilers, it is the policy of the Lancaster Iron Works to continue the high standards established by the former company, both in design and quality of workmanship.

Scientific construction and the use of the finest materials obtainable has given Monitor Boilers, an enviable reputation for fuel economy, durability and reliability. The sturdy steel shell is constructed of the best steel boiler plate similar to the material used for high pressure boilers. The "U" Tubes are of the highest grade Charcoal Iron such as is standard in locomotive construction. The base, grates, smoke-hood, dome and baffle plate are of cast iron and no part of the steel shell comes in contact with the floor of cellar or foundation.

As shown by the sectional view below, the shell of the Monitor "U" Tube Boiler is of all steel construction, the inner and outer shell plates are of ¼" flange steel, 2" x 2" steel rings, top, bottom and fire door, bull riveted with ⅝" button head rivets, fitted with 2" No. 9 gauge charcoal iron locomotive tubing and tested to a hydrostatic test of 100 lbs. per square inch, allowing a working pressure of 15 lbs. per square inch for low pressure.



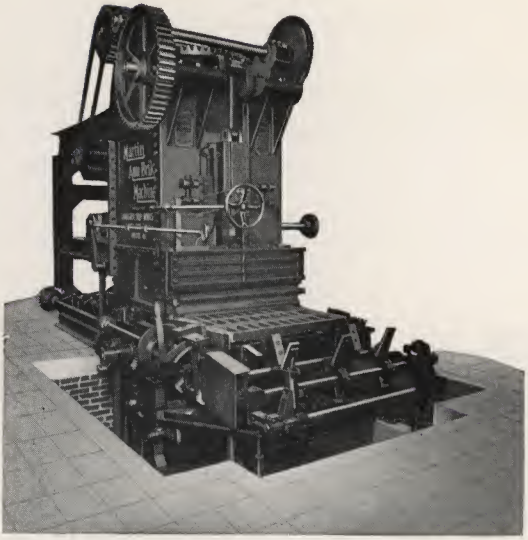
In our 35" and 40" boilers, we use a 3" x 3" steel ring, otherwise the construction is as stated above.

You will note by the arrangement of the "U" shaped tubes that each tube is in direct contact with the flame, thus causing a most rapid circulation. There are no threaded connections on the inside of the Monitor boiler, the tubes being expanded to the inner shell with no chance for the loosening of joints. At the termini of each tube there are threaded plugs in the outside shell providing for the easy replacement of tubes. Such replacements however are very rarely necessary during the lifetime of the boiler.

When special requirements are needed we can construct boilers for any specified pressure, built in accord with the A.S.M.E. and State Code.

Send for Bulletin containing sizes and general information, if interested.

Brick Machinery



The "Martin" Model 46
Autobrik Machine

Aside from Steel Plate Construction work, an important division of the Lancaster Iron Works, Inc., lies in the manufacture of Automatic Brick Making Machinery, known as AutoBrik Machinery. Our Brick Machinery Shops are the largest in the world, and Lancaster AutoBrik Equipment is now producing over 15% of the yearly output of building bricks in this country alone.

The AutoBrik Machine in the above illustration is made in several sizes varying in capacity from 50,000 to 120,000 brick per day. Its operations are entirely automatic and are a radical improvement over methods as used twenty years ago.

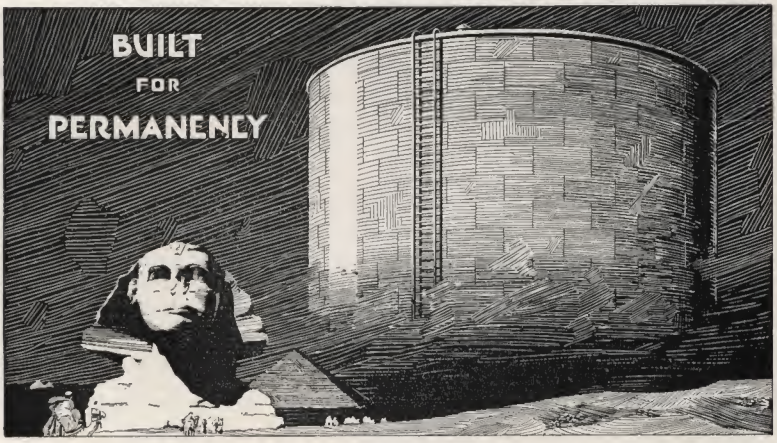
Other Brick Plant Equipment in the Lancaster Line includes Driers, Auto-Clay Cleaners, Pug Mills, Granulators, Disintegrators, Crushers, Represses—in fact every essential piece of equipment necessary to economical, high speed production of building brick.

LANCASTER IRON WORKS

SOUTH PLANT AND OFFICE
Prince and Hager Streets
Lancaster, Penna.

In addition to the large Plate Shops and Machine Shops at our South Plant, we also maintain in Lancaster, our North Plant, comprising over ten acres and where we have installed the most modern machinery and equipment for fabricating every kind of steel Plate Work.

Our modern Foundry, also located in Lancaster, makes a specialty of all kinds of Gray Iron Castings. Send for Foundry Bulletin, if interested.



LANCASTER TANKS

Lancaster Steel Plate Products

Field Storage Tanks
Towers and Standpipes
Stacks or Chimneys—
Self-Supported and Guyed Types
Breechings
Dust Flues
Air Ducts
Hot-Blast Mains
Coal Bunkers
Hoppers, Bins
Chutes
Penstocks
Flumes
Caissons
Troughs
Blast Furnaces
Barges
Dredges
Hearth Jackets
Downcomers
Gas Holders
Gas Producers
Cupolas
Stoves

Lancaster Pipe

Riveted or Welded Pipe
Hydraulic Mains
Gas Pipe
Bustle Piping
Land Pipe
Pontoon Pipe
Pipe Elbows
Pontoon Cylinders
Catamarans
Dredge Pipe Accessories
Ball Joints, Gate Valves
Y's, Etc.

INDUSTRIAL EQUIPMENT

Lancaster Apparatus and Machinery

Accumulators
Agitators, Acid
Agitators, Wash
Air Locks
Air Shafting
Annealing Boxes
Autoclaves
Barometric Condensers
Benzol Washers
Blast Furnace Equipment
Blow Cases
Casing, Iron and Steel
Casinghead Gasoline Absorption Towers
Casinghead Gasoline Accumulator Tanks
Casinghead Gasoline Blending Tanks
Casinghead Gasoline Equipment
Casinghead Gasoline Scrubber Tanks
Casinghead Gasoline Tanks
Centrifugals
Cement Kilns
Charging Boxes
Clarifiers
Concentrators
Cooling Towers
Creosoting Cylinders
Crystallizers
Denitrators
Digestors
Distillation Apparatus
Drum Dryers
Drying Ovens
Evaporators
Extractors
Equipment, Refinery
Kettles
Kilns
Ladles
Nitrators
Ore Bins
Plates and Structural Work
Pulverizers
Purifiers
Reducers
Refinery Construction
Re-evaporators
Regenerators
Retorts
Rotary Filters
Rotary Dryers Direct Fired
Rotary Dryers Indirect Fired
Saturators
Scale Boxes
Scrubbers
Steam Separators
Stills, Asphalt
Stills, Crude and Steam
Sulphonators
Surface Condensers
Vats
Vulcanizers
Washers
Water Softeners

Lancaster Tanks

Acid Tanks
Air Tanks
Asphalt Tanks
Barge Tanks
Blow-Off Tanks
Brine Tanks
Car Tanks
Casinghead Tanks
Cement Tanks
Chemical Tanks
Compressed Air Tanks
Condenser Tanks
Cyanide Tanks
Creosote Tanks
Dipping Tanks
Distributing Station Tanks
Elevator Tanks
Expansion Tanks
Filling Station Tanks
Filtering Tanks
Fuel Oil Tanks
Galvanizing Tanks
Garage Air Tanks
Gasoline Tanks
Gas Tanks
Grain Tanks
Grease Tanks
Hot Water Tanks
Hydro-pneumatic Tanks
Jacketed Tanks
Knocked Down Tanks
Lime Tanks
Linseed Oil Tanks
Mixing Tanks
Molasses Tanks
Naphtha Tanks
Oil Storage Tanks
Pressure Tanks
Quenching Tanks
Receiving Tanks
Rectangular Tanks
Rendering Tanks
Run Down Tanks
Separator Tanks
Settling Tanks
Soap Tanks
Sprinkler Tanks
Storage Tanks
Sugar House Tanks
Sulphuric Acid Tanks
Tar Tanks
Tender Tanks
Tower Tanks
Truck Tanks
Turpentine Tanks
Underground Tanks
Vacuum Tanks
Varnish Tanks
Vertical Tanks
Water Storage Tanks

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